THE MIDLAND COMPOUNDS

David & Charles Locomotive Monographs

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O. S. NOCK, B.Sc., M.I.C.E., M.I.Mech.E., M.I.Loco.E.

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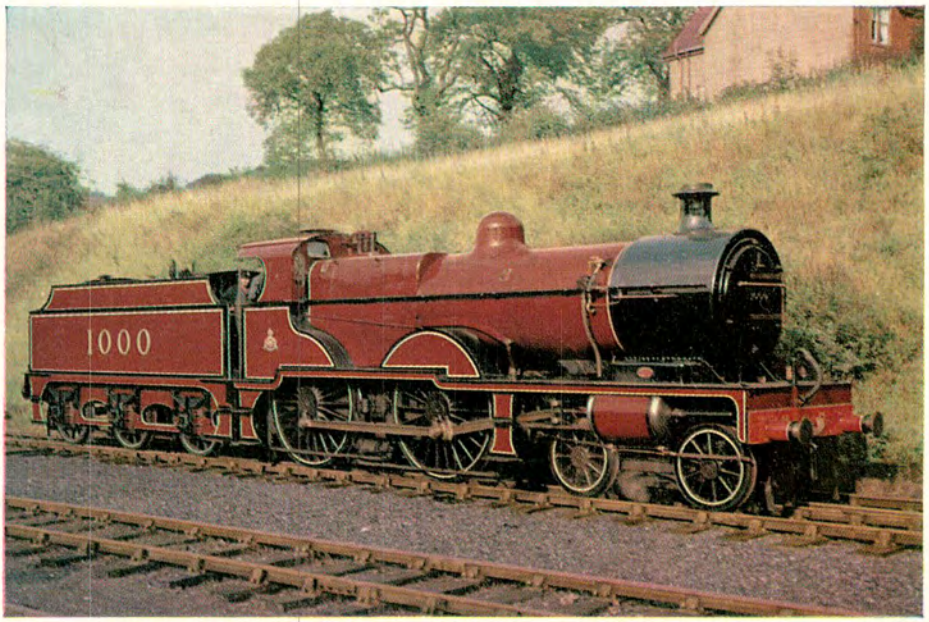

The first Midland compound, No. 1000. Originally built in 1902 as No. 2631, it was rebuilt and superheated in 1914, and it is in this latter condition that it is now preserved

DAVID & CHARLES LOCOMOTIVE MONOGRAPHS

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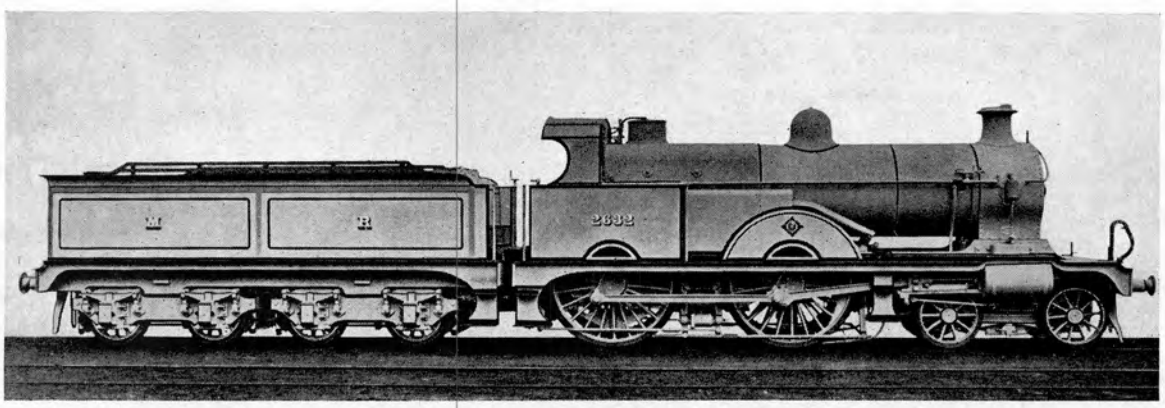

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CONTENTS

		PAGE
PREFACE		9
CHAPTER 1.	The Origin of the Smith Compound System	11
2.	The Midland Smith-Johnson Compounds	18
3.	The Deeley Compounds	34
4.	Comparisons and Tests: The Introduction of Superheating	49
5.	L.M.S.R. and the First Leeds-Carlisle Trials	62
6.	Dynamometer Trials, Settle & Carlisle Line, 1924-25	76
7.	The Preston-Carlisle Trials of 1925: Larger Compounds: Oil Firing	89
8.	L.M.S. Engine Power in the Melting Pot	100
9.	High Noon of the Compounds: Scotland 1926-35	110
10.	High Noon of the Compounds: The North Western and Midland Lines	126
11.	The Place of the Compounds in History	139
12.	Case Histories	150
MIDLAND COMPOUND CHRONOLOGY		155
ACKNOWLEDGMENTS		157
INDEX		159

PREFACE

The story of the Midland compounds, extending over nearly sixty years of British railway history, is not merely one of a single locomotive class, or groups of classes. In its origin, its development, its vicissitudes, and its triumph the Midland compound was, from the very outset, closely linked with other designs. It was involved probably in more competitive trials with very dissimilar engines than any other class, and in the story of these trials can be traced many of the principal trends in British locomotive practice. The compound principle, the introduction of superheating, the development of a more scientific approach to valve gear design, each in their turn received an important fillip from work centred upon the Midland compounds, while after the grouping of 1923 they formed for a time the focal point of the great controversy that raged over L.M.S.R. locomotive policy as a whole.

In presenting the story, I have been fortunate in receiving invaluable help from men who were intimately concerned with some of the vital points in Midland compound history. Mr. R. C. Bond, Technical Adviser to the British Railways Board, was a pupil of Sir Henry Fowler on the Midland Railway, and he has made his personal records available to me. These include the little-known indicator trials of 1923, between Derby and Manchester, and the first trials between Leeds and Carlisle made after grouping. From Mr. A. E. Robson, Chief Mechanical and Electrical Engineer, London Midland Region, I have had the loan of the private reports of various sets of trials, both between Leeds and Carlisle, and between Preston and Carlisle, in which the compounds were pitted against London & North Western, Lancashire & Yorkshire, and Caledonian locomotives. As regards the earliest trials of Midland compounds, made in 1902, I am indebted to the Editor of 'Engineering' for permission to reproduce the comprehensive results published in that journal shortly after the trials.

I have made extensive references to the files of 'The Engineer', 'The Locomotive' and 'The Railway Magazine', and am particularly indebted to the present Editor-in-Chief of 'The Railway Magazine' for permission to reproduce certain diagrams from his book 'Locomotive Management' and to quote from data published in the 'British Locomotive Practice and Performance' articles in 'The Railway Magazine'. Many friends have helped me with illustrations, and in this connection I would mention especially Mr. R. Crawshaw, Public Relations and Publicity Officer of the L.M. Region, and members of his staff, who have not only supplied me with many splendid photographs, but also have obtained working drawings depicting certain particular features of the locomotives. Another source of help has been the excellent booklet by Mr. D. F. Tee, published by the Railway Correspondence and Travel Society, and I am indebted to the Author and the Society for permission to reproduce the lists of shed allocations, and the building and withdrawal lists relating to the entire class.

Lastly, I am indebted to Olivia, my wife, who has, as usual, typed the manuscript. Like all railway enthusiasts she has her own favourites, and even though the Midland compounds are not among the 'Top 10' of her locomotive affections, this has reduced neither the enthusiasm nor the speed with which she did her part of this particular job.

O. S. NOCK

Silver Cedars, High Bannerdown, Bath
May 1964

CHAPTER 1

THE ORIGIN OF THE SMITH COMPOUND SYSTEM

The Midland Railway of old had a graciousness and beauty that was unsurpassed among the trunk lines of Great Britain. I know only too well that behind the brilliant façade presented to the travelling public there was a hard and relentless management; a record of tough dealing with labour, and of discord in high places. But the public saw and appreciated the handsome carriages, the smartly-kept stations, and the immaculately-clean crimson lake engines. Moreover, right down to the turn of the century Midland engines all had a slender, aesthetic charm that completely eschewed the tendency of massiveness and modernity that was beginning to develop elsewhere. Samuel Waite Johnson virtually enforced economic running upon his drivers by keeping his boilers small, and fitting relatively large cylinders. His beautiful engines could not be thrashed, because if any driver attempted such treatment he would be short of steam in no time.

And then quite suddenly there came a change. With Johnson still in office at Derby, and remaining very much in command of all affairs, there emerged from the works a class of large 4—4—0 locomotives that immediately flouted all the previous canons of Midland practice. By the standards of our own times they would have been set down as exceedingly handsome engines; but to admirers of the old Midland they came as something of a shock. Gone were the graceful domes, with Salter valves on the top; gone was the exquisitely-shaped brass safety valves casing over the firebox, and instead of the flowing curves of the coupled wheel splashers were a functional detached affair for the leading pair, and a rectangular box-type, *à la Crewe,* for the trailing pair. The attenuated cabs of tradition on the Midland, that harmonised perfectly with the outlines of the older engines, looked angular and inadequate on the rear splashers of the Belpaires, as the new engines became known. It only needed the so-called 'wagon-top' of the firebox, in company with the large high-pitched boiler, to complete an *ensemble* that was completely alien to the Derby tradition.

All the same, the first of the new engines, which took the road in 1901, were finished in the magnificent style of old. The crimson lake was richly adorned with brass bands over the leading splashers, with much black and yellow lining, and the number was carried in raised brass figures on the rectangular rear splashers. The Midland was nevertheless entering into the competition for big engines, with big boilers, and the Johnson 'Belpaires' could certainly be set alongside the Caledonian 'Dunalastairs', the North Eastern 'R' class, and the first South Eastern and Chatham 'copper-tops'—not to mention the 'Claud Hamilton', and the South Western 'T9' 4—4—0s. It was however with the North Eastern that the greatest affinity began to develop. At that time Walker Mackersie Smith was Chief Locomotive Draughtsman at Gateshead, while Wilson Worsdell was Locomotive Superintendent.

Today, when looking back to locomotive history upwards of 70 years ago one can be amused, and perhaps a little awed by the degree of autonomy enjoyed by those then in command. In an age of standardisation when every new railway development is heralded by publicity handouts, broadcast comments, television interviews and such like, one can reflect somewhat wistfully upon a time when the chief officers of the leading railways did much as they liked, and no more than a few of them cared to make public the principles they were using, still less the results they obtained. Smith was a man of tremendous personality, who *did* read papers on his experiments and developments before the Institution of Mechanical Engineers. What is not generally realised, however, is that while he was exceedingly active at Gateshead his eldest son

was employed at Derby, and had already made his mark there by the part he had played in the perfecting of the piston valves designed by his father.

Quite apart from the connection between the work of the Smiths, father and son, relations between Wilson Worsdell and S. W. Johnson were most cordial, and unlike the closed-shop attitude that surrounded the activities of many railway manufacturing centres at that time, there was a free and unfettered exchange of information and ideas between Gateshead and Derby. During the time of the elder Worsdell the North Eastern was very much a 'compound' line, using the simple but rather odd Von Borries system. This used only two cylinders, of different sizes, and both inside the frames; and although the thrust from each was approximately the same, from high-pressure steam in the small cylinder, and low-pressure steam in the large one, there was an unbalancing effect upon the engine as a whole due to the larger weight of moving parts on the low-pressure side. Nevertheless the Worsdell—Von Borries compounds on the North Eastern were otherwise well-proportioned engines, and could run at what were very high speeds for the 1890s, often well in excess of 80 m.p.h.

In England locomotive engineers in general were proceeding rather cautiously towards compound expansion, and apart from T. W. Worsdell's work on the North Eastern it was only on the London & North Western that any extensive application of the principle was made in the nineteenth century. It was at Crewe that F. W. Webb developed the oddest layout of cylinders, by having two high pressure, exhausting into one low pressure. The whole principle of the machinery in a compound engine is to divide the work of propulsion equally between the high and low-pressure systems, and, in view of this, to have two high pressure and one low pressure seemed the very reverse of logical. In practice it meant that the two high-pressure cylinders had to be very small, and the one low-pressure enormous. Even so, in most of Webb's three-cylinder compounds the low-pressure cylinder was not large enough, and the engines were choked in consequence. On the continent of Europe four-cylinder compound locomotives were coming into vogue in the 'nineties', and in his later compounds on the London & North Western Webb adopted four-cylinders arranged similarly in basic layout. The Crewe engines were not so effective as their continental counterparts, through the incorporation of a number of features that choked the flow of steam and made them sluggish at express speed.

The four-cylinder compound system was applied to locomotives of the 4—6—0 type working on one of the heaviest roads in Europe—if not the whole world—namely, the St. Gothard Railway, where in ascending to the great tunnel under the Alps the line is on a gradient of 1 in 37 to 1 in 40 for many miles, while traversing the famous systems of spiral tunnels, near Wassen on the northern ramp, and near Giornico on the southern side of the main tunnel. But in addition to having some four-cylinder compounds the St. Gothard Railway used some 4—6—0 locomotives of the same general proportions but having only three cylinders—one high pressure, and two low pressure. This arrangement was as logical as Webb's was the reverse for all three cylinders in these St. Gothard engines were roughly the same size—actually $17\frac{3}{8}$ in. dia. high pressure, and $18\frac{7}{8}$ in. low pressure.

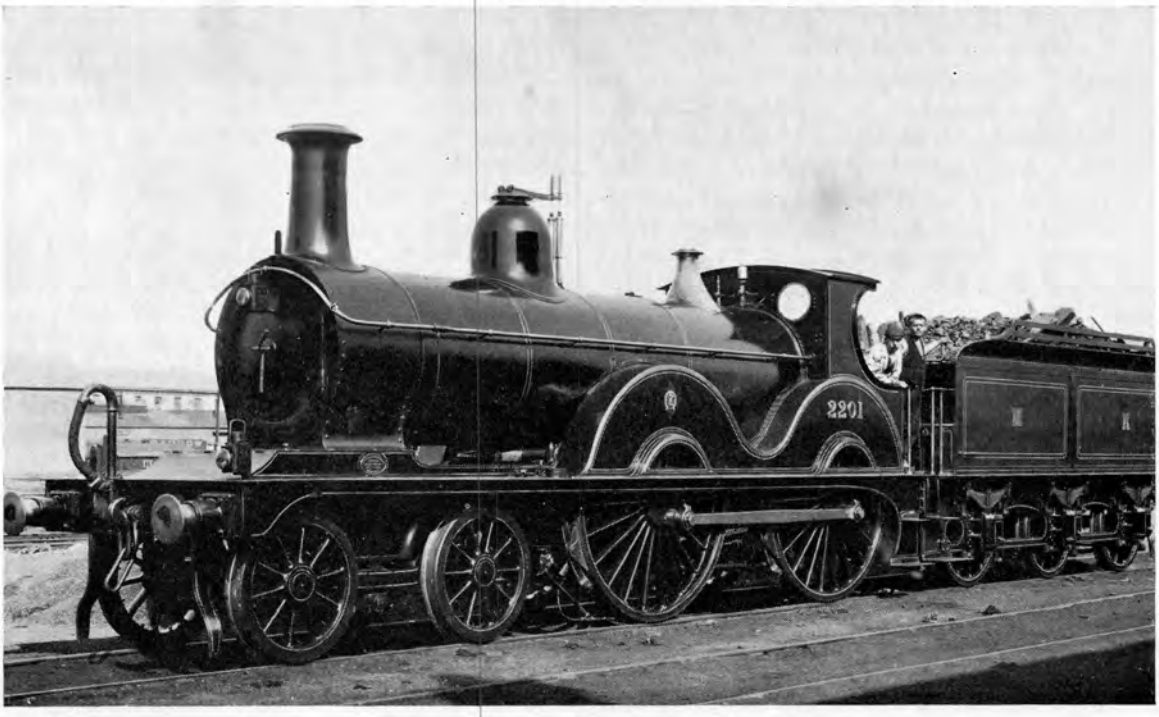
These compounds proved very powerful and successful engines, and with the standard express trains of the day, consisting of six saloon carriages and a luggage van, they climbed the 1 in 37 gradients at the high speed of 30 m.p.h.

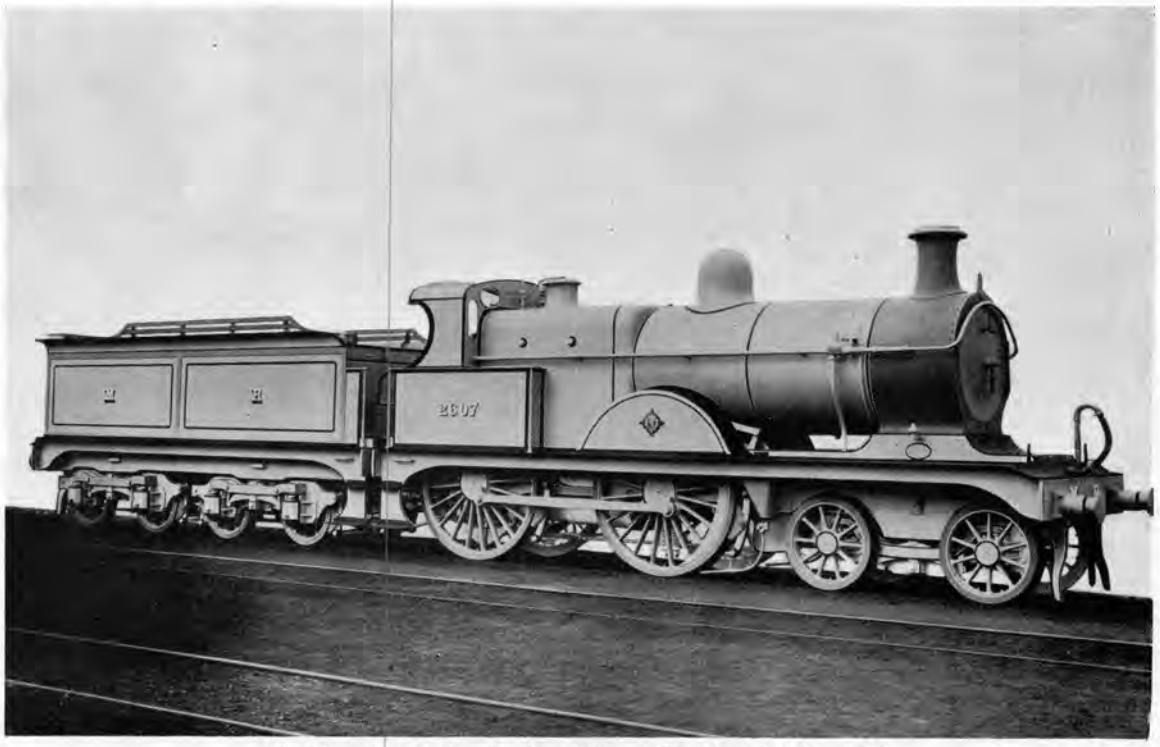
Whether W. M. Smith was aware of these Swiss locomotives we are not to know, but in 1898 the latest and largest of the North Eastern two-cylinder

Walter Mackersie Smith; chief locomotive draughtsman North Eastern Railway

The Midland style, to 1900: one of Johnson's beautiful 2-4-0 express locomotives

Artistry in locomotive design: one of the Johnson small-boiler express passenger 4-4-0s





The Change in Style at Derby: a Johnson Belpaire 4-4-0, No. 2607

Von Borries compounds, No. 1619, was replaced by a new three-cylinder compound, of which the general arrangement drawing was titled 'W. M. Smith's Patent Locomotive'. A point of difficulty in connection with all compound locomotives is that of starting. Webb's three-cylinder engines on the North Western used to get hopelessly stuck. But the Worsdell—Von Borries engines on the North Eastern had Worsdell's automatic intercepting valve. At first live steam from the boiler was admitted to both high and low-pressure cylinders; but as soon as the pressure in the receiver, from the exhaust of the high-pressure cylinder, rose sufficiently, the intercepting valve was opened, and ordinary compound working began. No special action from the driver was required, and only one reversing screw was used to link up both high and low-pressure gears. The proper proportion of cut-off in the two cylinders was regulated by the different positions of the levers in the reversing shaft and the different lengths of the hanging links.

In Smith's three-cylinder compound No. 1619 the controls were more complicated, because the designer desired to take full advantage of the flexibility in control that his system of compounding could provide. The engine was started very simply as a two-cylinder simple engine, with live steam from the boiler admitted only to the two low-pressure cylinders. Then, when the train was fairly on the move a so-called 'change-valve' was operated by the driver to initiate compound working. Then high-pressure steam from the boiler was admitted only to the high-pressure cylinder; direct admission of live steam to the low-pressure cylinders was cut off, and the latter were supplied from the intermediate receiver with steam exhausted from the one high-pressure cylinder. In proportioning the cylinders Smith was careful to avoid the mistakes that had been made in many earlier compound engines through restrictions in the flow of steam. In some cases the port areas through valves were inadequate, and in others the low-pressure cylinders were not large enough. In a compound engine the steam circuit, from the regulator through the cylinders to the blast pipe, is much longer and more complicated than in a single expansion machine. There are many more points in the circuit where the free flow of steam can be impeded; but Smith made sure that all was well in this respect on the N.E.R. 4—4—0 No. 1619.

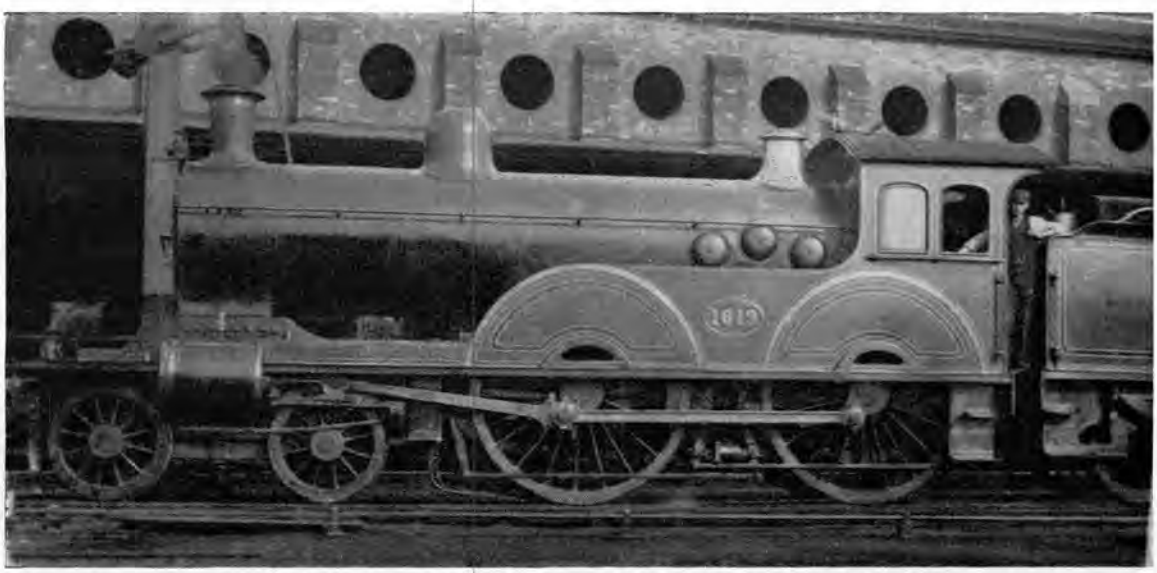
One outstanding attribute of the steam locomotive, that was not fully appreciated in many quarters until steam traction was in course of replacement by diesel in this country, is its capacity for

making transitory outputs of power far beyond the maximum sustained capacity of the boiler. A skilful driver and fireman, by building up the fire, and manipulating the injectors so as to have an absolutely full boiler, can then, for a brief period, steam the engine at a considerably higher rate than that which could be sustained indefinitely. It is an extremely useful source of reserve power, particularly when climbing a heavy bank. The boiler may be mortgaged in the process, with pressure dropped, water level reduced, or both. But as the heavy sections are likely to be followed immediately by downhill stretches there is normally no trouble in 'paying off the mortgage', restoring water level and steam pressure while the locomotive is coasting, or at any rate working under easy steam.

On the Midland Railway the most severe work was usually experienced on the Settle and Carlisle line, and between Derby and Manchester, and on these long inclines the opportunity of having a little 'extra' towards the conclusion of an ascent is worth a good deal to a driver. On the North Eastern engine No. 1619 Smith provided the means of obtaining that 'extra' in an interesting way. An auxiliary valve was fitted that enabled the driver to admit a limited amount of live steam direct from the boiler to the low-pressure cylinders *while working compound*. In other words, while the low-pressure cylinders were taking steam from the intermediate receiver, which had been through the high-pressure cylinder, they received additional steam direct. The extra volume of steam passing through the low-pressure cylinders could, in certain circumstances, have a choking effect and by giving rise to excessive back pressure counteract and eliminate the very advantages that this method, in principle, provides. This difficulty Smith overcame by his arrangement of the valve gear.

The designer of a locomotive is apt to find himself in a cleft stick. In trying to produce a machine that shall be as simple as possible to manage, and shall at the same time have a high overall efficiency, he is often faced with the problem that a feature that will increase the efficiency will add to the complication in handling. At the time the North Eastern compound engine No. 1619 was built complications in handling were not so serious as they became in later years. Locomotives engaged in top link express passenger work had regular crews. There were never more than two pairs of men allocated to an engine, and in working the same engine, week in week out, there was every chance to gain familiarity with every feature. In such circumstances any driver who persistently failed to take advantage of special items fitted to his engine was just put on another job.

Assured by the fact that engine No. 1619 would be skilfully handled, Smith fitted independently controlled reversing gears for the high and low-pressure cylinders. The driver had two reversers to operate when notching up, but there was no need to operate them uniformly. If the engine was being



The first Smith compound: North Eastern Railway 3-cylinder 4-4-0 No. 1619

Samuel Waite Johnson, locomotive superintendent Midland Railway, 1873–1903

worked very hard, and some live steam was being admitted to the low-pressure cylinders, the driver could lengthen the cut-off in the low-pressure cylinders to avoid any choking effect there might be through the large volume of low-pressure steam trying to pass through. There were no hard and fast rules to go by in such circumstances. Successful working relied entirely on the good judgment of the driver. But a good engineman gaining complete familiarity with his machine—through driving no other!—would very quickly master the technique. This certainly happened on the North Eastern with engine No. 1619, though for other reasons she remained the only one of her kind. In view of her undoubted success, and the influence the design was to have elsewhere, in later years, the reasons for her isolation are worth recalling.

At the time of her experimental running new locomotives of enhanced tractive capacity were required urgently. In contrast to the trend of affairs on the London & North Western Railway at that same period the policy at Gateshead was to advance towards new ideas with the utmost caution. It was one thing to have one novel 'patent' locomotive that could be under close observation from the drawing office, and handled by a driver specially selected for the qualities needed to 'nurse' an engine of this kind; it would have been quite another to have ten or a dozen of them, and to rely on them to handle the heaviest and fastest trains on the system. So, while No. 1619 remained very much an experimental unit the famous 'R' class of two-cylinder simples was turned out, incorporating the well-tried features of Smith's patent piston valves. The success of these 'R' class engines was so immediate and so complete as to obscure the success of the compound, and it was no more than natural that Wilson Worsdell put off the decision as to whether Smith's three-cylinder compound system should be adopted as the future standard.

As emphasising the locomotive position on the Midland and North Eastern railways at this interesting point in the development of express passenger locomotive practice, the basic dimensions of the Johnson 'Belpaires' and the Worsdell 'R' class may be set alongside.

COMPARATIVE 4–4–0 LOCOMOTIVES

Railway	Midland	North Eastern
Class	"2608"	"R"
Coupled wheel dia.; ft. in.	6 – 9	6 – 10
Cylinders dia. × stroke; in.	19½ × 26	19 × 26
Adhesion Wt.; tons	34.1	35.2
Boiler:		
Barrel dia. ft. in.	4 – 8	4 – 7¾
Heating surface sq. ft.		
Tubes	1374	1383
Firebox	145	144
Total	1519	1527
Grate Area; sq. ft.	25	20
Boiler Pressure; p.s.i.	180	200
Total wt., engine only; tons.	51.6	51.7

So far as nominal tractive effort was concerned there was little difference between the two designs, as the higher boiler pressure on the North Eastern 'R' class was to some extent offset by the larger cylinders and smaller coupled wheels of the Midland engines.

The really significant difference lay in the design of the fireboxes—not so much in the use of the Belpaire shape on the Midland engine but in the size of the grate. The North Eastern engine was designed with a deep, narrow firebox in which a very thick fire would be employed. The Gateshead top link express engines of the day were fired mostly on soft Tyneside coals which gave good results in these conditions, whereas much of the best Midland running relied on hard Yorkshire and Nottingham coals which could be fired quite thinly on the grate. Although he had provided engines with boilers vastly greater than those of previous Derby traditions Johnson was still giving the most careful consideration to economies in working, and

a large grate thinly covered with top-grade hard coal could give excellent results. It is worth while pondering a little on this point, because the practice came to be developed considerably in later years on the Midland.

Even at that time the Midland was a line severely restricted in the axle loads its permanent way could carry. The '2781' series of 'Belpaires', introduced in 1902, weighed 52¾ tons in working order, and they were the heaviest engines permitted on any part of the line south of Leeds. Incidentally, the tenders were nearly as heavy as the engines, scaling 52½ tons in working order, with 4,500 gallons of water, and 5 tons of coal. There seems little doubt nowadays that the first 'Belpaires' represented an experiment rather than an abrupt change in policy, because the construction of 4—4—0 locomotives in the old style, with small boilers, and all the traditional boiler mountings of old was continued for a time. Johnson's final design in this respect, the '60' class of 1898, had 7 ft. coupled wheels, but had cylinders of the same size as those of the 'Belpaires' 19½ in. dia. by 26 in. stroke. The boiler pressure was 170 lb. per sq. in., though the total heating surface was no more than 1,233 sq. ft., against 1,519. Construction of these engines continued until 1901, though the later ones had 19 in. cylinders, and a total heating surface of 1,193 sq. ft. These latter engines were without doubt the finest of all Johnson's 'small boiler' designs, the 'singles' included, and they were great favourites on the Anglo-Scottish expresses over the entire line from St. Pancras to Carlisle, Aisgill Summit included, despite their 7 ft. coupled wheels.

In the north, of course, there was a great deal of double-heading. The Midland Railway was following the general trend of operating development common at that time. Express train schedules involved start-to-stop average speeds of little more than 50 m.p.h., even south of Nottingham and Leicester, and with these prevailing the latest of the Johnson small-boilered engines, when expertly driven, could keep time with loads of up to 300 tons. On the Settle and Carlisle road it was another matter, and it was to those northern fastnesses that the 'Belpaires' first went. Engines of the 1902 batch were sent to Trafford Park for working the Manchester expresses over Peak Forest Summit. Nevertheless despite their much larger boilers the nominal tractive effort represented an increase of no more than 10 per cent. over that of the '60' class, and still more powerful engines would be needed if the incidence of double-heading was to be appreciably reduced. Although the Settle and Carlisle line had been substantially built, and laid with the heaviest rails then used anywhere in Great Britain, the civil engineer was apparently unwilling to accept anything larger than a 4—4—0, and it was in these circumstances that thoughts at Derby turned towards compounding.

CHAPTER 2

THE MIDLAND SMITH-JOHNSON COMPOUNDS

The first two Midland compounds, Nos. 2631 and 2632, were built at Derby in January 1902, and were in most essentials enlargements of the North Eastern engine No. 1619. All three cylinders drove on the leading coupled axle. The outside cranks were at right angles, and the inside cranks bisected the obtuse angle between the other two. The accompanying drawing shows a cross-section of the front end of the locomotive. Distribution of steam to the high-pressure cylinder was controlled by piston valves located directly beneath the cylinder, while the low-pressure cylinders were fed by slide valves, with vertical faces. The cylinder dimensions, 19 in. diameter high pressure, 21 in. low pressure, with a common stroke of 26 in., have remained constant throughout the history of the class, except for a short period from 1923 to 1925 when a batch was built with cylinders having diameters of $19\frac{3}{4}$ in. high pressure and $21\frac{3}{4}$ in. low pressure.

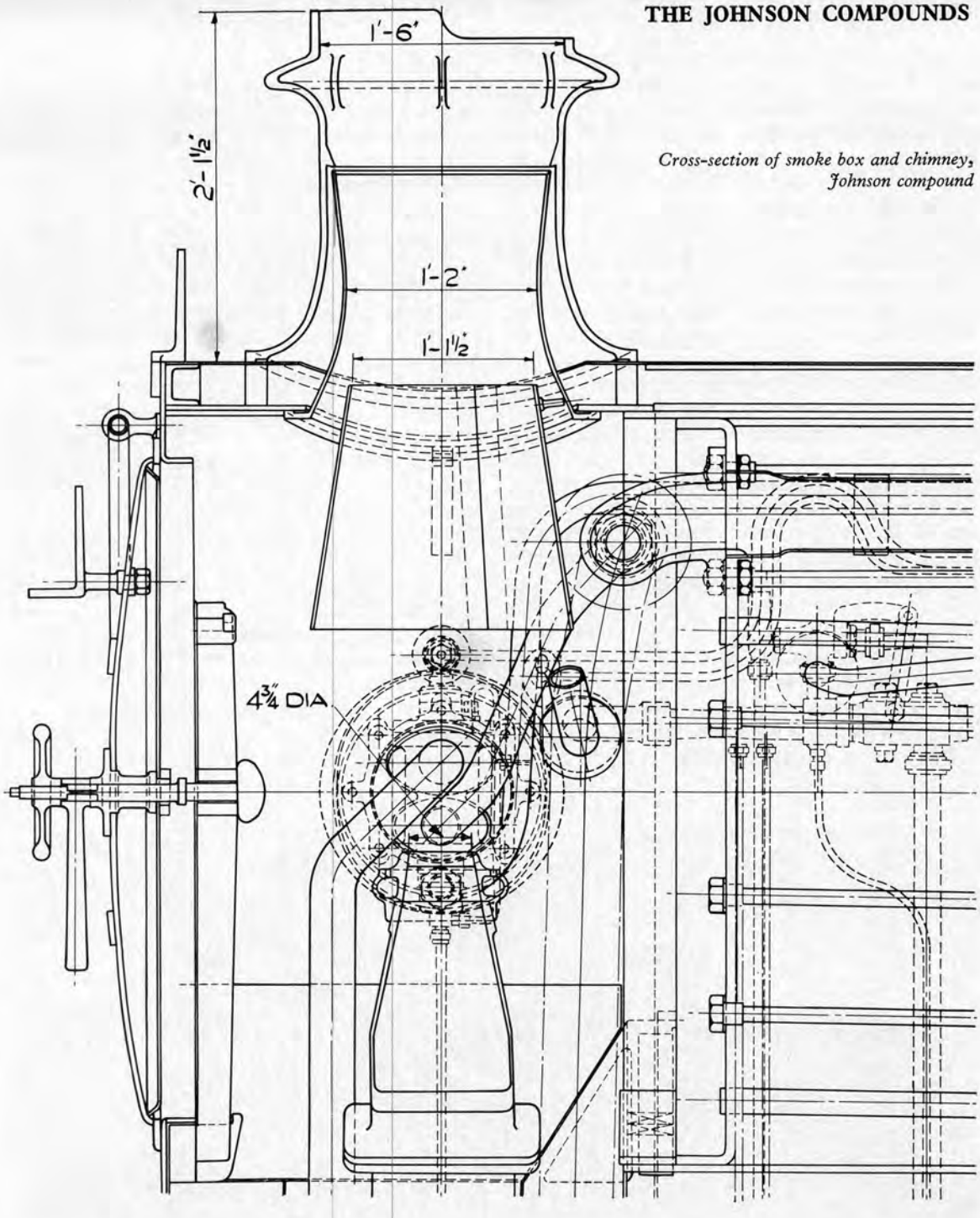
The high-pressure cylinder exhausted direct to the steam chest common to the two low-pressure cylinders, without the intervention of any intermediate steam pipe.

As originally designed it was arranged that simultaneously with the admission of steam to the high-pressure steam chest steam at a pre-determined pressure was automatically admitted also to the low-pressure steam chest by a specially constructed regulating valve on the right hand side of the smokebox, looking forward. The regulating valve was so arranged that when the maximum pressure allowed in the low-pressure steam chests was attained further supply of steam directly from the boiler was automatically cut off. The general distribution of power output from the three cylinders was so contrived that although the boiler pressure was 195 lb. per sq. in. none of the pistons were ever subjected to pressure equal to that on the pistons in a simple engine working with a boiler pressure of 170 lb. per sq. in. In passing it would seem curious that this should have been included as a design feature, because it immediately threw away one of the great advantages of a compound engine—that is to increase the range of expansion of the steam.

When working compound the pressure in the low-pressure steam chests was found to vary be-

Engine No. 2631 fitted with indicator shelters for the Leeds—Carlisle trials of 1902

The first Midland compound: Johnson's 4-4-0 No. 2631, later No. 1000 and now preserved



Cross-section of smoke box and chimney, Johnson compound

tween 40 and 60 lb. per sq. in. according to the position of the reverser; but in working a heavy train up a steep gradient increased power could be obtained by admitting live steam from the boiler direct to the low-pressure steam chests for as long as might be necessary, or, of course, as long as the boiler would stand for it. The amount of steam that could be admitted in this way could be regulated by the driver between the maximum and minimum limits of pressure; he could, in fact, vary the low-

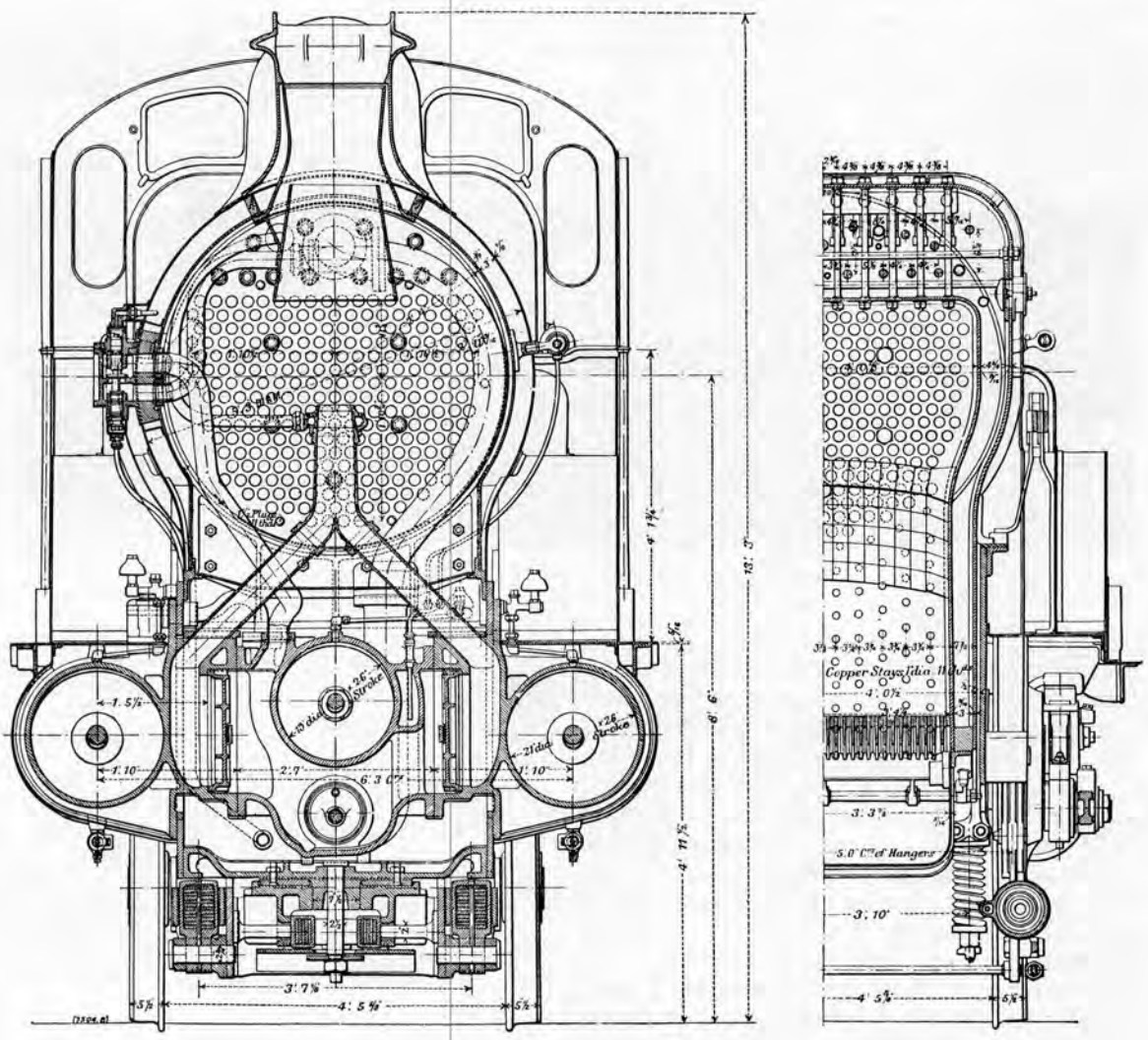
pressure steam chest pressure to suit the work in hand. Independent reversing was provided for the high-pressure and low-pressure valve gears, though the mechanism was such that one handle would actuate both gears simultaneously if required. These controls certainly gave the driver a multiplicity of adjustments, that sound every bit as extensive as those then being provided on the de Glehn compounds in France. To prevent excessive forward or back pressure on the high-pressure pistons when starting non-return valves were arranged so that steam could pass from the low-pressure steam chest into either end of the high-pressure cylinder.

All this not only sounds complicated; it *was* complicated, though the complications had been contrived within a beautifully simple and handsome exterior. The new compounds, with their large boilers, outside cylinders, and huge bogie tenders, developed the new modern 'look' that was coming into Midland motive power; but why Johnson, with his previous attention to the aesthetics of locomotive design should have put on square splashers is difficult to understand. One can understand that Derby had not yet reached the stage of providing really adequate cabs, but those rear splashers, both on the 'Belpaires' and on the compounds rather defy all logical explanation. Nevertheless, the *ensemble* made up a highly original and distinctive design, and in the year 1902 they were, of course, finished with the gorgeous profusion of polished brass and ornate lining that characterised Midland locomotives of Johnson's day. The initials 'M.R.' on the tenders were painted and the number on the cab side sheets was rendered in raised brass figures.

The boiler was very large for a 4—4—0 locomotive of that period, and the Belpaire firebox had a grate area of no less than 26 sq. ft. To some commentators this latter feature and its subsequent enlargement to 28.4 sq. ft. would appear to hold the key to the very successful performance of the engines in later years, though the details of the boiler were to pass through several stages before finality was attained. Originally, the two experimental engines had different arrangements of the tubes. In both the barrel was 11 ft. 7 in. long and the diameter 4 ft. 8 in. inside on the second ring; the firebox heating surface in each was 150 sq. ft. But engine No. 2631 had plain copper tubes $1\frac{3}{4}$ in. inside diameter, giving a tube heating surface of 1,448 sq. ft., while No. 2632 had steel Serve tubes of $2\frac{3}{4}$ in. outside diameter. The front portion of the grate was hinged so that it could be lowered, and the fire and clinker remaining at the end of the day's work pushed through into the ashpan. Taken all round, a tremendous amount of thought and care had been put into the design of these engines.

The dimensions of Nos. 2631 and 2632 as originally built are shown on the opposite page :

One of the second batch of Smith-Johnson compounds, No. 2634, later No. 1003



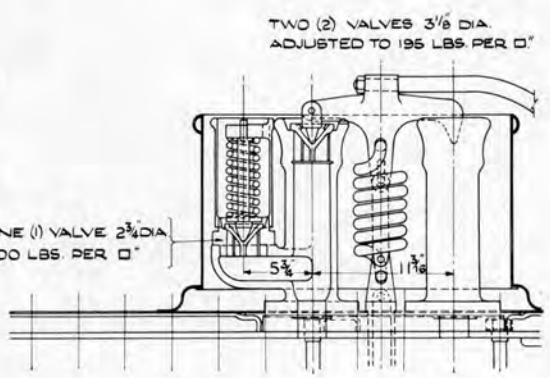
Diameter of cylinders	H.P. 19in.;	L.P. 21	
Stroke	26in.		
Diameter of driving wheels	7ft.		
Diameter of bogie wheels	3ft. 6½in.		
Centre of boiler from rails	8ft. 6 in.		
Diameter of barrel (second ring)	4ft. 8in. inside		
Length of barrel	11ft. 7in.		
Length of firebox	8ft. 6in. outside		
Grate area	26 sq. ft.		
Heating surface, firebox	150 sq. ft.	150	sq. ft.
Heating surface, tubes (copper)	1448 sq. ft.	(Serve) 1569.8	sq. ft.
Total	1598 sq. ft.	(with Serve Tubes) 1719.8	sq. ft.
Working pressure	195 lb.		
Capacity of tender	4500 gallons		
Diameter of tender wheels	3ft. 6 in.		
Wheel-base, engine	24ft. 3 in.		
Wheel-base, bogie	6ft. 6 in.		
Wheel-base, tender	16ft. 10in.		

Total wheel-base	51ft. 8⅜in.		
Total length over buffers	60ft. 10 in.		
Weights empty	tons	cwt	qrs
On bogie wheels	19	0	2
On driving wheels	18	4	0
On trailing wheels	17	15	0
Total engine	54	19	2
Tender	30	3	0
Total weight of engine and tender	85	2	2
Weights in working order	tons	cwt	qrs
On bogie wheels	20	12	3
On driving wheels	19	11	2
On trailing wheels	19	6	0
Total weight of engine	59	10	1
Tender, with 2½ tons of coal on	52	12	3
Total weight of engine and tender	112	3	0

The second Midland compound: engine No. 2632 as originally built

In October of 1902 No. 2631 was put through a comprehensive series of tests between Leeds and Carlisle. The two engines were at first confined to that road, No. 2631 being stationed at Leeds and No. 2632 at Carlisle, each in the exclusive charge of one particularly able driver. The tests of October 1902 were certainly prophetic of the many tests of later years carried out with compounds over that road. It was not an ideal one from the viewpoint of the Midland locomotive department. The main line between Manchester and St. Pancras was much more convenient. The latter provided collar work if anything heavier than that demanded on the Settle and Carlisle, and for sustained fast running south of Leicester. And, of course, both sections of the London—Manchester route could be tested as very convenient single-home turns from Derby. At the same time it must be remembered that testing was less complicated then. The Midland Railway did not possess a dynamometer car, and the data recorded of coal and water consumption was related to the indicated rather than the drawbar horsepower.

The Midland also used what was surely the most slender and confined of shelters for the engineers engaged on this job of indicating. Whereas other railways built fairly large wooden boxes right round the fronts of the engines to be tested, in which a team of four or five engineers could be accommodated the Midland affair must have been cramped for two!



Details of the safety valves

The tests of 1902 were very fully reported in the columns of *Engineering*, and I am indebted to the present editor of that journal for permission to quote freely from earlier issues, and to reproduce a number of diagrams and drawings. There is first of all the working of the regulating valve in starting, and the following table gives details of performance at speeds between 10 and 20 m.p.h. The actual indicator diagrams are reproduced, and it will be seen that when the regulating valve is admitting high-pressure steam to the low-pressure cylinders a small amount of work is still being done in the one high-pressure cylinder. The short spell with the regulating valve was effectively used to boost the rate of acceleration, and note will be taken of the high pressure of 160 lb. per sq. in. on the low-

pressure side. The indicator diagrams show that the mean effective pressure in the cylinders was no less than 142 to 144 lb. per sq. in. Obviously, working for any appreciable time in this way, at such a cut-off as 78 per cent. in cylinders 21 in. diameter by 26 in. stroke, would have drained the boiler in no time. But for a short period it was most effective.

Turning now to the actual test runs, details were published in *Engineering* of the complete running of six trips, as follows:

The coal consumption figures cover a considerably greater number of runs, and these will be discussed in more detail later. Two of the finest runs of all were those made on September 5, 1902 going north, and on October 12, 1902 on the southbound journey, and details of the running, as between Hellifield and Carlisle, have been extracted from the graphs and put into the tabular form most familiar now to students of locomotive performance in all its diversities.

I LEEDS TO CARLISLE

Date	Train ex-Leeds	Loads tons tare		
		Leeds Skipton	Skipton Hellifield	Hellifield Carlisle
21- 8-02	10.6 a.m.	300.3	111.6	240
5- 9-02	5.33 p.m.	282½	282½	229
12-10-02	10 a.m.	248	248	248

II CARLISLE TO LEEDS

Date	Train ex-Carlisle	Load, tons tare Carlisle to Leeds
21- 8-02	3.55 p.m.	174
16- 9-02	3.55 p.m.	174
12-10-02	4 p.m.	248

5.33 p.m. LEEDS—CARLISLE (as from Hellifield)

Load: 229 tons tare
Engine: 3-cylinder compound No. 2631

Hellifield—Aisgill	28.4 miles; 37 min.
Aisgill—Appleby	17.5 miles; 15 min.
Appleby—Carlisle	30.8 miles; 27 min.

Total 76.7 miles in 79 min. start to stop

Location	Speeds m.p.h.
Hellifield	Start
Settle Junction	63
Helwith Bridge	39/44
Horton	39
Ribblehead	35 (min)
Blea Moor	37
Dent Head	56
Hawes Junction	65
Aisgill	55
Kirkby Stephen	81/86
Ormside	79
Appleby	65
Little Selkeld	79/75
Lazonby	68/55
Armathwaite	68/59
Cumwhinton	76

Manchester Express in the Chevin Valley, near Derby, hauled by compound No. 2633

COMPOUND ENGINE No. 2631

Speed m.p.h.	Regulator opening	Cut-off % H.P.	Cut-off % L.P.	Boiler Pressure p.s.i.	Receiver Pressure p.s.i.	L.H.L.P. cyl.	H.P. cyl.	R.H.L.P. cyl.	TOTAL
10.2	¾	69	78	195	80	120	106	132	358
11.5	full	69	78	195	160	302	76.6	297	675.6
13.6	full	69	78	185	85	184	151	185	520
19.1	full	69	78	190	85	258	206	243	707

The up run with the 4 p.m. train on October 12, 1902 is of even greater interest, because details of the indicated horsepower are available. On this occasion the 48.3 miles from Carlisle up to Aisgill were climbed in 64 min. 46 sec. and the speeds on the ascent were as shown in the following table:

Location	Speeds m.p.h.	Reg. opening	I.H.P.	Cut-off % H.P.	Cut-off % L.P.
Scotby	35	½	974	65	60
Cotehill	45	½	981	63	57
Low House	42	—	—	—	—
Armathwaite	60	½	919	58	52
Baron Wood Tunnel	53	—	—	—	—
Lazonby	68	½	733	58	52
Langwathby	52	¼	915	58	52
Culgaith	58	—	—	—	—
Newbiggin	51	½	843	55	48
Long Marton	60		—		
Appleby	50		—		
Ormside	66	½	825	55	48
Crosby Garrett	42	½	945*	60½	54
Smardale Viaduct	50	½	956	60½	54
Kirkby Stephen	40	½	973*	63	57
Birkett Tunnel	37	—	—		
Mallerstang	43	—	—		
—	38	full	967	60½	54
Aisgill	37	full	1001½*	63	57
Hawes Junction	65/60	½	832	55	48
Dent Head	65	½	864	58	58
Blea Moor	68		—		

*Regulating valve partly open

There are several interesting points about the working of the engine on this run. The adjustment of the controls was left entirely to the discretion of the driver. There was no insistence upon particular regulator or reverse positions in order to get good indicator diagrams, and it will be seen that it was only on the last stage up to Aisgill that the regulator was fully open. Of course, while a tare load of 248 tons was quite a train for the year 1902 on the Midland Railway it was small compared with what was done later over this route, and the values of individual horsepower were substantially beaten less than two years later in the first dynamometer car trial run with the new L.N.W.R. 4—4—0 No. 513 *Precursor*. In view of the rivalry that was to develop between Derby and Crewe designs 20 years later it is perhaps not out of place to mention that against the best Midland compound figure of 1,001½ I.H.P. at 37 m.p.h. on the last stage of the climb to Aisgill *Precursor* registered 1,168 I.H.P. at precisely the same speed in accelerating southward out of Crewe. The North Western engine showed itself capable of sustaining 1,000 I.H.P. indefinitely at speeds of 55 to 60 m.p.h.

There is, of course, no doubt that the North Western engine was being worked a great deal harder than the Midland compound. Cut-offs of 63 per cent. in the high-pressure cylinder, and 57 per cent. in the low, would be equivalent to about 25 per cent. in a simple engine, and when much of the work was done at still shorter cut-offs, and with the regulator a long way from being fully opened it is clear that No. 2631 had a considerable amount of power in hand. In view of the fact that this experienced driver had the opportunity of making independent adjustments of the cut-offs in the high and low-pressure cylinders it is interesting to note the actual cut-offs he did use corresponded to the proportions that were afterwards fixed between high pressure and low pressure when Deeley altered this feature of the compound and took away the independent adjustment. It may well be that on these tests the driver of No. 2631 was using the facility of notching up both sets from the one handle. It would have been most interesting to see how the driver would have acted if he had been required to work a 300-ton train up from Carlisle to Aisgill in the same running times.

Before passing on to a discussion of the results so far as coal consumption is concerned, I must add that the greatest interest in the performance of Midland compounds was being taken by the locomotive department of the North Eastern Railway, at Gateshead, and particularly by W. M. Smith himself. In this connection I have had some interesting corres-

pondence with Mr. John S. MacLean, of Jesmond, Newcastle-on-Tyne, himself the author of a notable book on North Eastern Railway locomotives. MacLean knew W. M. Smith, and his family, and he has told me that when the trials of No. 2631 were in progress Smith several times went across to Carlisle to see the engine during her turn-round time between trips, and to discuss performance. Although I have no definite information on the subject one can be fairly sure that Smith's eldest son would have been closely connected with the trials. On one of these visits to Carlisle, Smith took John MacLean with him, though not actually to travel on one of the compound test trains. MacLean has told me how impressed he was with the *size* of the Midland engine, although by that time far bigger engines had been turned out at Gateshead.

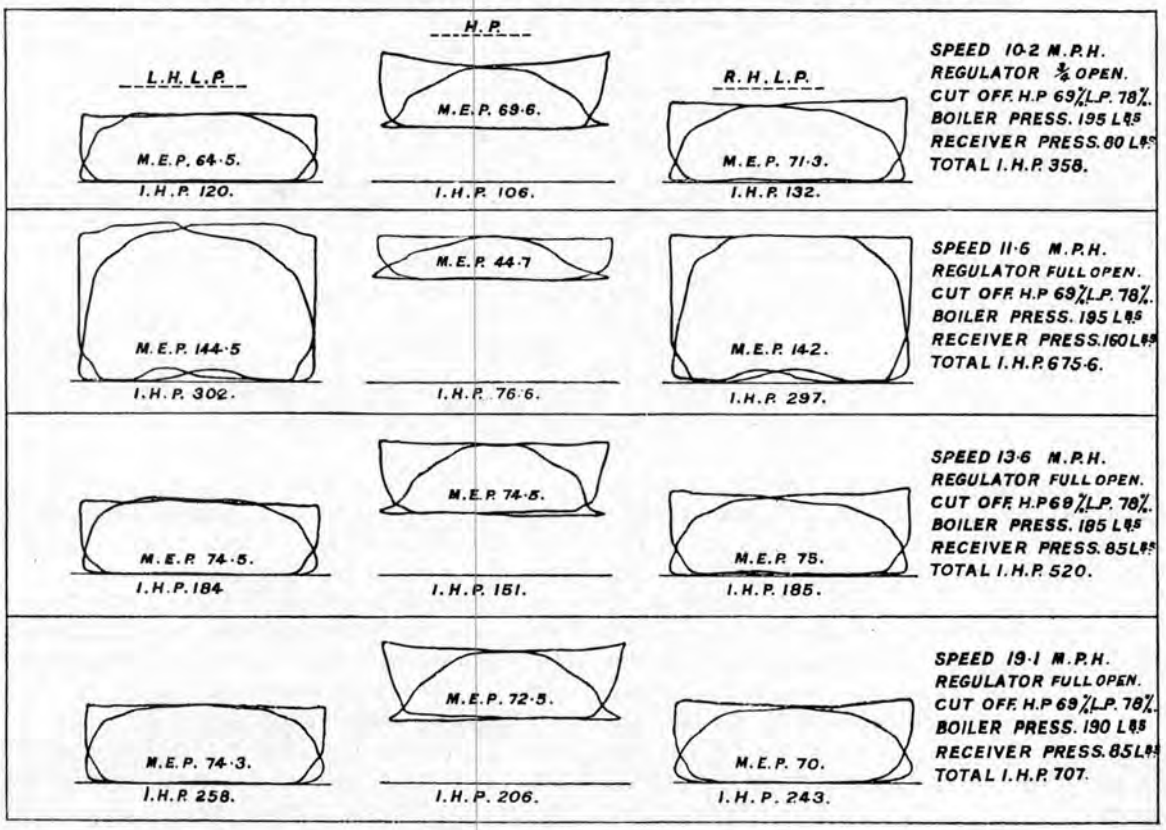
The coal consumption trials covered three groups of runs, one in each direction with lightly loaded trains, and one group in the down direction with medium trains. The full results, as published in *Engineering*, at the time, are given in the accompanying tables, but the results may be summarised as follows:

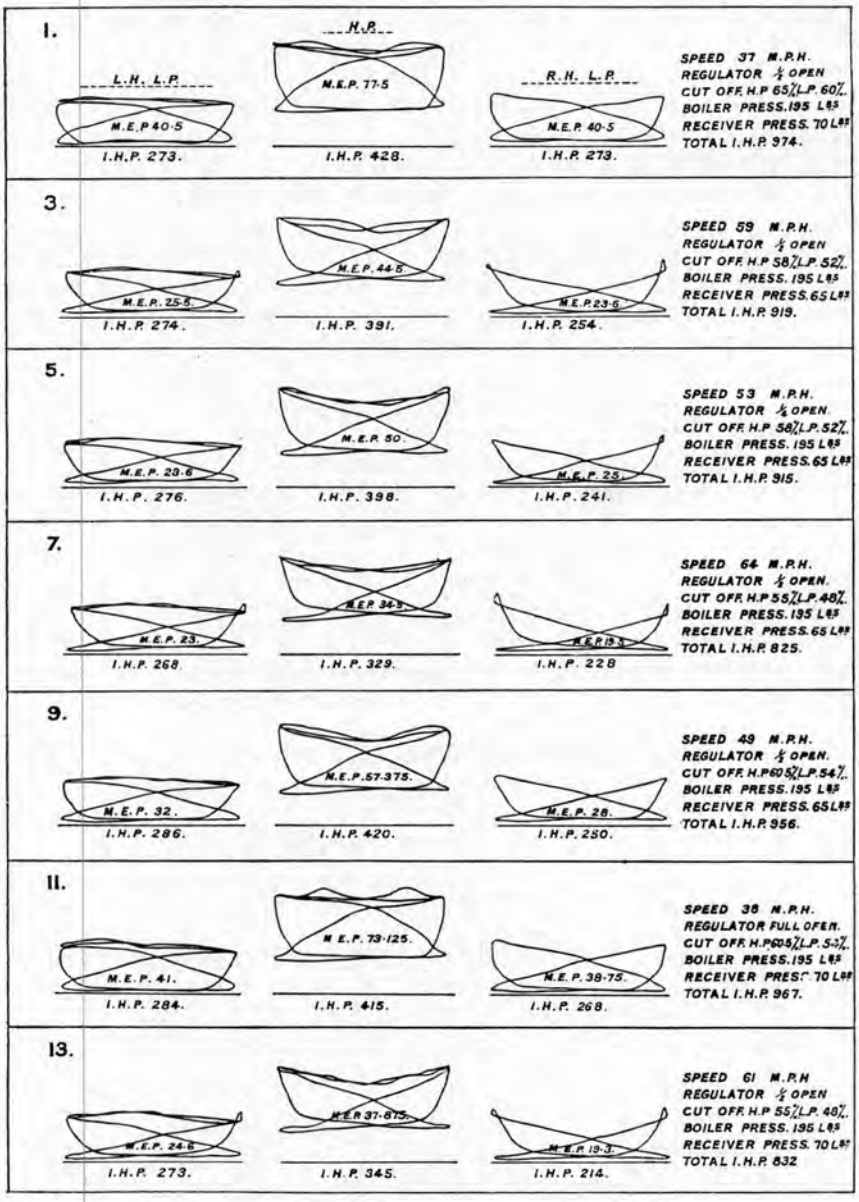
LEEDS—CARLISLE TRIALS—1902

Train	Direction	Load tons	Booked average speed m.p.h.	Net average speed m.p.h.	Coal lb. per mile	Coal per gross ton mile lb.	Water lb. per lb. of coal
10.6 a.m. .	Down	156	45.2	48.4	33.9	0.128	8.48
1.28 p.m. .	Down	251	50.5	52.5	45.5	0.128	7.33
3.55 p.m. .	Up	153	48.4	51.2	25.4	0.095	9.45

Typical indicator diagrams

MIDLAND RY ENGINE Nº 2631. AT SLOW SPEEDS.

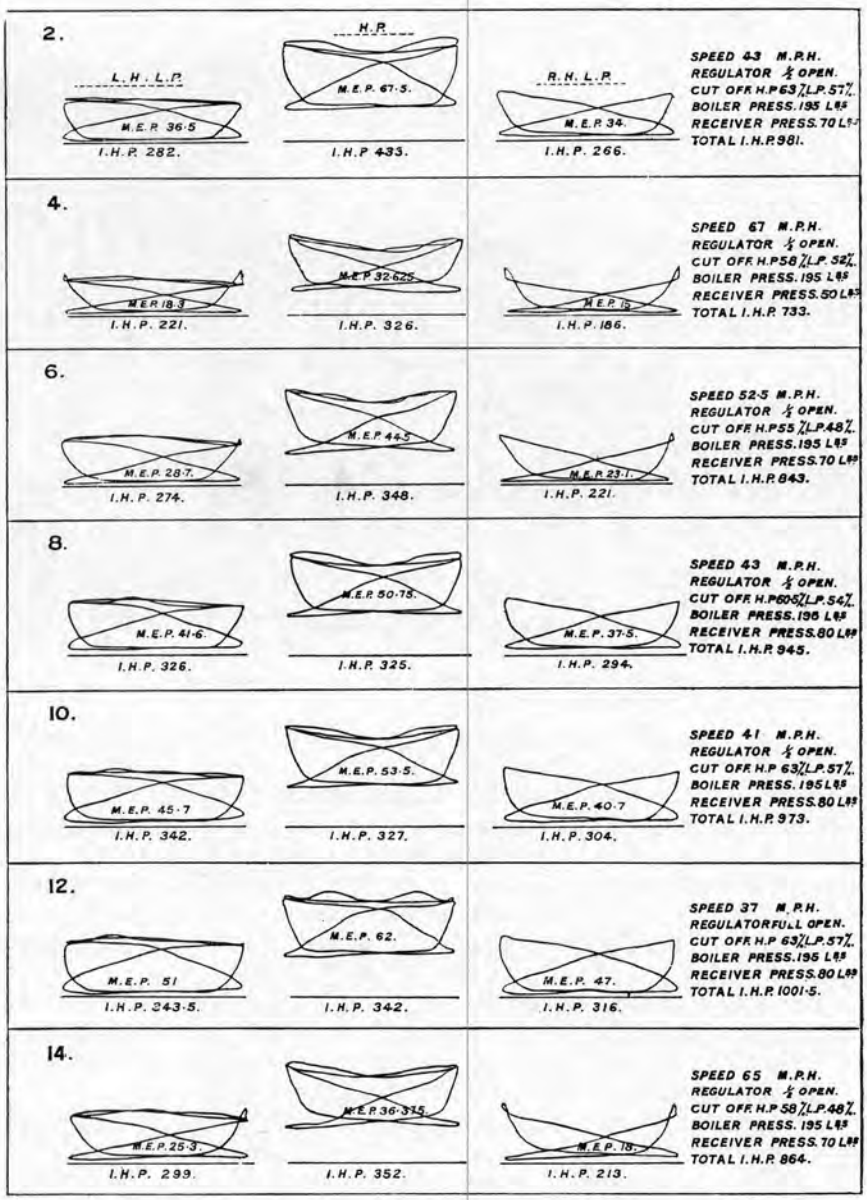




Typical indicator diagrams

The 10.6 a.m. down express had booked stops at Keighley, Skipton and Hellifield, and so had a considerably harder task than the 3.55 p.m. up non-stop from Carlisle to Leeds, on an easy allowance, for such a load, of 140 min. for the 113 miles. The 1.28 p.m. down with the heaviest load had the sharpest timing of all, and showed it in the coal consumption of the engine. The above table gives the average figures for six trips on the 10.6 a.m., five on the 1.28 p.m. and six on the 3.55 p.m. up. Although there was considerable variation in the weather conditions the general performance of the engine was highly consistent from day to day. For the down journeys the tender was loaded with first-class Yorkshire coal, from Manvers Main Colliery, near Wath; but as the larger tables show the tender was replenished at Carlisle with coal from Featherstone Colliery. Nevertheless the coal consumption on the return journeys with the 3.55 p.m. train was exceptionally low, in pounds per mile.

On one of these trips with the 3.55 p.m. up there was some very fast running on September 16, 1902. The load was one of 174 tons behind the tender, and the 48.4 miles to Aisgill took no more



Typical indicator diagrams

than 57 min. Time was gained on the easier part of the road, with speeds of over 75 m.p.h. at Lazonby and 74 m.p.h. at Ormside Viaduct. The main climb to Aisgill was made at almost exactly the same speed as on the more heavily loaded run previously mentioned in detail, with a train of 248 tons. After passing Blea Moor, however, the train of September 16 ran at a steady and unvarying speed of 83 m.p.h. from Ribblehead to Settle, finally attaining 85 m.p.h. at Settle Junction, and making the exceptional average speed of 79.7 m.p.h. from passing Blea Moor to the stop at Hellifield. The total time for this run of 76.8 miles was 81 min. start to stop.

The report in *Engineering* emphasises that the engine was not forced at any time during the runs, of which details are tabulated. It is interesting to find, however, that on the run when indicator diagrams were taken that the regulating valve was opened partially, admitting some live steam direct to the low-pressure cylinders and increasing the receiver pressure from the usual 65 to 70 lb. per sq. in. to 80 lb. per sq. in. The difference in the shape of the low-pressure cylinder indicator diagrams can be seen by comparing No. 8, taken on

The last of the Johnson compounds, No. 1004 (originally 2635), on up Leeds and Bradford express near Mill Hill

the hard ascent north of Crosby Garrett, with No. 9 at higher speed over Smardale Viaduct; or again in comparing Nos. 11 and 12 on the final ascent to Aisgill. Diagram No. 11 was taken at 38 m.p.h. working ordinary compound, and No. 12 was taken with the regulating valve opened sufficiently to increase the receiver pressure from 70 to 80 lb. per sq. in. The cut-offs were slightly increased too, but the effect of opening the regulating valve was to change the I.H.P. values in the three cylinders: left hand low pressure, high pressure, and right hand low pressure respectively, from 284, 415 and 268 to 343½, 342 and 316. From the diagrams it is clear that the valve setting on the right hand low-pressure cylinder was slightly out of adjustment, as the power developed in that cylinder was consistently lower than the corresponding left hand cylinder. When the regulating valve was partially open there was a beautifully even distribution of the power between the three cylinders.

It would have been most interesting to have seen this excellent engine fully extended, in the same way that the superheater compounds were opened out in the trials carried out on this route from 1923 onwards. But some indication of what she could do can be gauged from one occasion, when unfortunately she was not being indicated, when for the greater part of the distance from Ormside Viaduct up to Aisgill she was worked in 69 per cent. cut-off high pressure, and 70 per cent. low pressure, and occasional use of the regulating valve. The engine steamed freely against the continual use of both injectors. In such conditions of working the indicated horsepower probably exceeded 1,200, which was a remarkable figure for the year 1902. In any event the tests carried out with engine No. 2631 establish the first Midland compounds as excellent engines though nevertheless ones requiring specialist handling on the part of the drivers.

In the meantime the sister engine No. 2632 was also doing excellent work. Charles Rous-Marten recorded a run on the 11.30 a.m. express from St. Pancras, which was then booked to cover the 76.8 miles from Hellifield to Carlisle in 88 min., when this time was cut to 80 min. 57 sec. with a load of 250 tons. Speed was sustained at 36 to 40 m.p.h. up the long 1 in 100 ascent from Settle Junction to Blea Moor, and then a very fast descent followed to Carlisle, with a time of only 42 min. 9 sec. for the 48.4 miles from Aisgill to the stop, and a maximum speed of 88 m.p.h. This same engine also did some magnificent work when Rous-Marten was travelling on an up express from Carlisle, loaded to 240 tons. Appleby was passed in the fast time of 34 min. 33 sec., and on the first hard piece of climbing, from Ormside, the minimum before Crosby Garrett was 45 m.p.h. against 42 m.p.h. on the test run when No. 2631 was indicated. Speed then rose to 53½ m.p.h. over Smardale Viaduct, and the minimum speed at Aisgill was the exceptional one of 43

m.p.h. The time for the last 17½ miles from Appleby was only 23 min. 5 sec., making the quite outstanding time of 57 min. 38 sec. from Carlisle.

One imagines that No. 2632 was being extended for Rous-Marten's benefit, and on passing Aisgill the train was already some 7 min. ahead of time. Despite this she was taken down to Settle Junction in hurricane style, quickly accelerating to a maximum speed of 92 m.p.h. which was sustained for 2 miles. This was a range of maximum speed that to my knowledge was never attained later by the Deeley and Fowler compounds. Once only I have seen a record as high as 86 m.p.h. with the latter engines, and generally speaking 80 to 83 m.p.h. was about the general maximum. I would imagine that the independent control of the high-pressure and low-pressure valve gears would be a great help towards very free running at high speed. With the combined gear of the later engines throttling and exhaust losses became very severe at high speed; but if, as in the original Johnson engines, the drivers had been able to lengthen the cut-off in the low-pressure cylinders, and by so doing increase the port openings, freer running would very likely have been possible. It is noticeable on No. 2631 that when the driver wanted really hard work he lengthened the low-pressure cut-off to something greater than that of the high-pressure cylinder, whereas in the combined gear of the Deeley engines the low-pressure cut-off was about 10 per cent. less—71 per cent. H.P., 61 per cent. L.P. in the 7th notch of the reverser.

The original compound, No. 1000 (originally 2631), on up Anglo-Scottish express passing Armathwaite

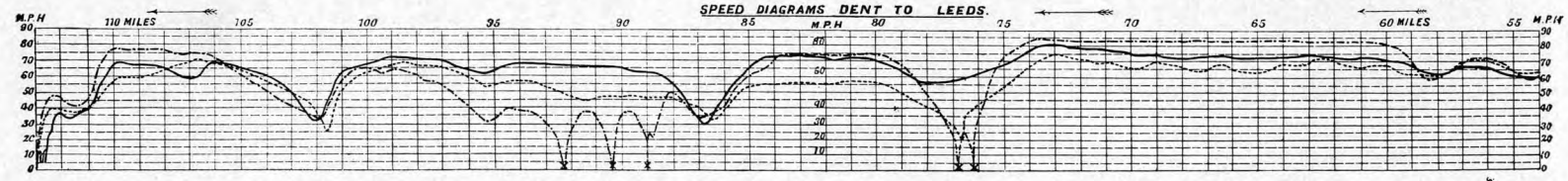
After renumbering and fitting with 6-wheeled tender, the second compound, No. 1001 (originally No. 2632), on down Anglo-Scottish express near Elstree

In the last months of Johnson's career three more Smith compounds were built at Derby: No. 2633 in July 1903, No. 2634 in September, and No. 2635 in November. These three engines were generally similar to Nos. 2631 and 2632 except that they did not have independent control of the high pressure, and the low-pressure valve gear. The occasions on which it was used were apparently so few as to not justify the extra complication, though as I have just said it was a refinement that permitted of exceptional performance when needed. The three new engines had all the other Smith features, though they could be distinguished from Nos. 2631 and 2632 by their straight running plates over the cylinders. No. 2635 had Serve tubes when first built. The new engines were all sent to Kentish Town, and they were soon doing excellent work. At that period many of the Scotch and Manchester expresses were loading up to really heavy tonnages, before the general re-arrangement of the timetables, and Rous-Marten recorded one extremely good run with No. 2634 on which a 350-ton train was taken from St. Pancras to Leicester, 99.1 miles, in 110 min. 14 sec., inclusive of an intermediate stop at Bedford. Over the first section the 49.8 miles were covered in 53 min. 33 sec. start to stop; while the second stage, of 49.3 miles, with its steep ascents to Sharnbrook, Desborough and Kibworth Summits, took 56 min. 41 sec. The minimum speeds of 40, 43 and 48½ m.p.h. respectively at these three points showed very fine hill-climbing. Unfortunately the details quoted by Rous-Marten are not sufficient for a calculation of the horsepower involved to be made.

★ ★ ★

The details of performance by engine No. 2631, as originally published in *Engineering*, are shown on pages 30-33.

TRIALS OF COMPOUND LOCOMOTIVE ON THE MIDLAND RAILWAY; SECTIONS OF LINE.



x Indicates Signal Checks.

CARLISLE TO LEEDS.

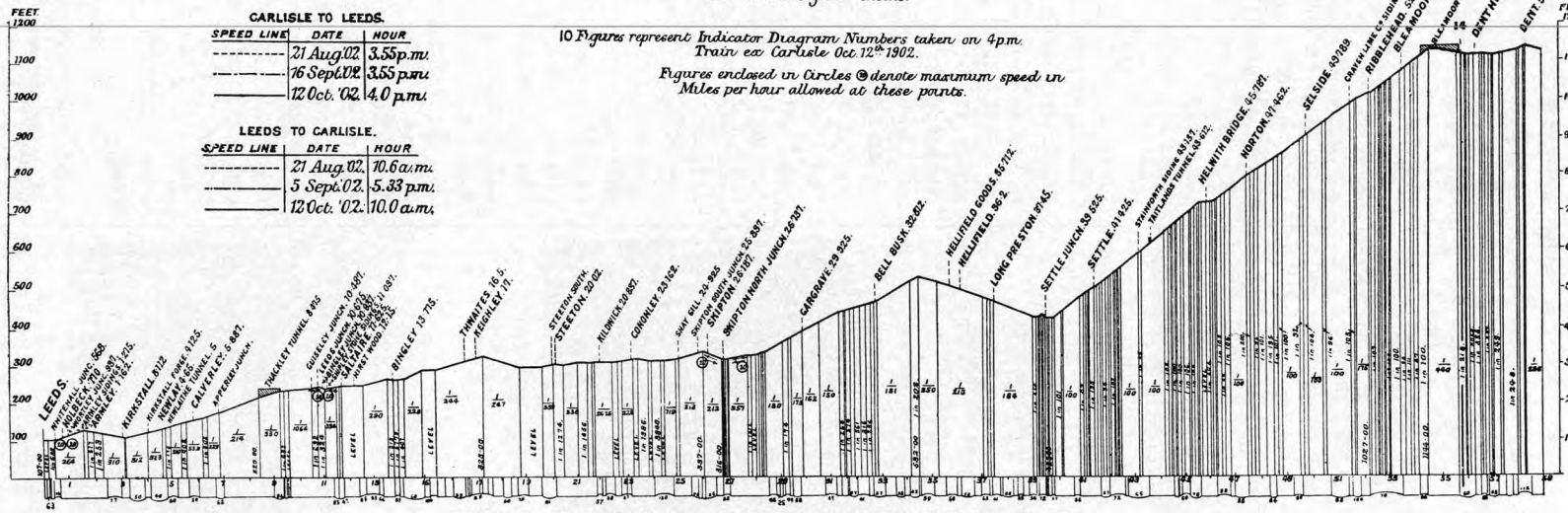
SPEED LINE	DATE	HOUR
----------	21 Aug. '02.	3.55 p.m.
-·-·-·-·-	16 Sept. '02.	3.55 p.m.
————	12 Oct. '02.	4.0 p.m.

LEEDS TO CARLISLE.

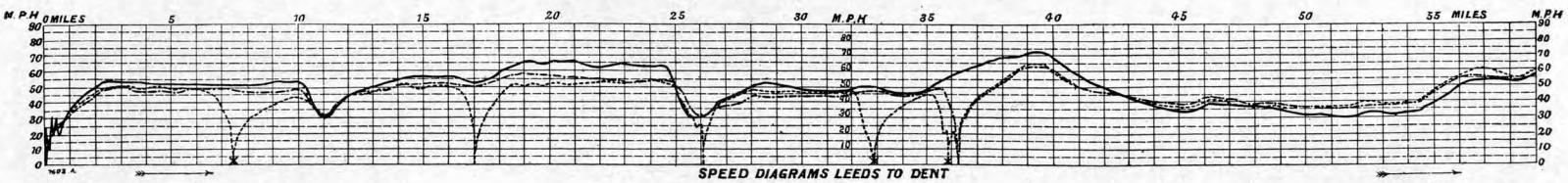
SPEED LINE	DATE	HOUR
----------	21 Aug. '02.	10.6 a.m.
-·-·-·-·-	5 Sept. '02.	5.33 p.m.
————	12 Oct. '02.	10.0 a.m.

10 Figures represent Indicator Diagram Numbers taken on 4 p.m. Train ex Carlisle Oct. 12th 1902.

Figures enclosed in Circles ⑩ denote maximum speed in Miles per hour allowed at these points.

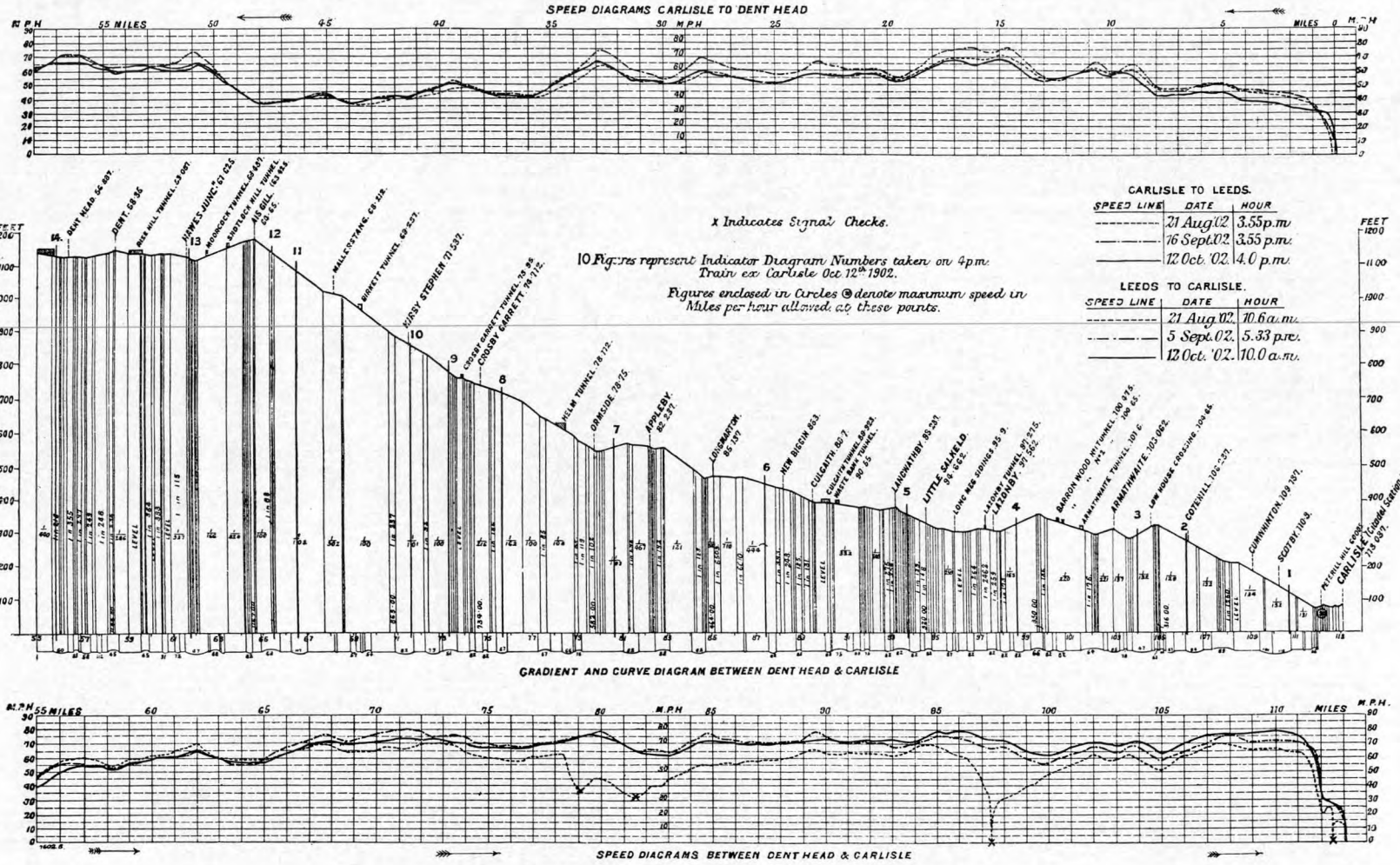


GRADIENT AND CURVE DIAGRAM OF MIDLAND RAILWAY BETWEEN LEEDS AND DENT



SPEED DIAGRAMS LEEDS TO DENT

TRIALS OF COMPOUND LOCOMOTIVE ON THE MIDLAND RAILWAY; SECTIONS OF LINE.



EXPERIMENTS ON THREE-CYLINDER COMPOUND LOCOMOTIVE; MIDLAND RAILWAY.

TABLE. I.—PARTICULARS OF WORKING OF COMPOUND ENGINE "No. 2631."

DATE.	VEHICLES.	WEIGHT. Mean of Coaches, Passengers, and Luggage. (tons)	WEIGHT. Engine and Mean of Tender. (tons)	WEIGHT. Mean of Train, Total. (tons)	SECTION OF LINE AND LENGTH. (miles)	Number of Intermediate Stops and Starts.	RUNNING TIMES. Booked. (min.)	RUNNING TIMES. Actual. Delays by Signals and Special Stops. Included. (min.)	RUNNING TIMES. Actual. Delays by Signals and Special Stops. Deducted. (min.)	RUNNING SPEEDS. Booked. (miles per hour)	RUNNING SPEEDS. Actual. Delays by Signals and Special Stops. Included. (miles per hour)	RUNNING SPEEDS. Actual. Delays by Signals and Special Stops. Deducted. (miles per hour)	COAL CONSUMED. Per Mile. (lb.)	COAL CONSUMED. Per Mile per Ton of Mean Total Weight. (lb.)	WATER EVAPORATED. Total. (gals.)	WATER EVAPORATED. Per Pound of Coal. (lb.)	WATER EVAPORATED. Per Pound of Coal from and at 212 deg. Fahr. (lb.)	REMARKS. *Re* COAL.	REMARKS. GENERAL.
10.6 A.M., LEEDS TO CARLISLE.																			
Oct. 17	Leeds to Skipton .. 9=12½	207	110.9	317.9	Leeds to Ais Gill 64.65	3	93	88	86	41.7	44.1	45.1	31.8	.123	3320	9.2	11.2	Manvers Main	Stopped at Lazonby and Armathwaite. Light side wind.
	Hellifield to Carlisle .. 6= 8	141	106	247	Ais Gill to Carlisle .. 48.387	2	57	56	48	50.9	51.8	60.5							
	Leeds to Carlisle	152.6	105.4	258	Leeds to Carlisle.. .. 113.037	5	150	144	134	45.2	47.1	50.6							
Oct. 18	Leeds to Skipton .. 9=12½	212.5	111	323.5	Leeds to Ais Gill.. .. 64.65	3	93	90.25	88.25	41.7	43	44	37	.14	3230	7.7	9.39	Ditto.	Special stop at Armathwaite.
	Hellifield to Carlisle .. 6= 8	148	106.5	254.5	Ais Gill to Carlisle .. 48.387	1	57	57	53	50.9	50.9	54.7							
	Leeds to Carlisle	158.5	105.5	264	Leeds to Carlisle.. .. 113.037	4	150	147.25	141.25	45.2	46	48							
Oct. 27	Leeds to Skipton .. 11=14	221	110.7	331.7	Leeds to Ais Gill 64.65	3	93	90	89	41.7	43	43.6	32.1	.118	3290	9	10.98	Ditto	Light side wind.
	Hellifield to Carlisle .. 7= 9	150.5	106.4	256.9	Ais Gill to Carlisle .. 48.387	1	57	57	51	50.9	50.9	56.8							
	Leeds to Carlisle	164.5	105.5	270	Leeds to Carlisle.. .. 113.037	4	150	147	140	45.2	46.1	48.4							
Oct. 29	Leeds to Skipton .. 11=14½	236	110.8	346.8	Leeds to Ais Gill.. .. 64.65	3	93	93	90	41.7	41.7	43	37	.135	3350	8	9.76	Ditto	Foggy, and rails greasy.
	Hellifield to Carlisle .. 7= 9	223	106	329	Ais Gill to Carlisle .. 48.387	..	57	54	52	50.9	53.7	55.7							
	Leeds to Carlisle	168.8	105.2	274	Leeds to Carlisle.. .. 113.037	3	150	147	142	45.2	46.1	47.7							
Oct. 30	Leeds to Skipton .. 9=12½	207.5	111.1	318.6	Leeds to Ais Gill.. .. 64.65	3	93	92	90	41.7	42.1	43	33.1	.129	3150	8.4	10.24	Ditto	Stopped at Lazonby and Armathwaite. Fine; light side-wind.
	Hellifield to Carlisle .. 6= 8	141.9	106	247.9	Ais Gill to Carlisle .. 48.387	2	57	57	51	50.9	50.9	56.8							
	Leeds to Carlisle	150.2	105.8	256	Leeds to Carlisle.. .. 113.037	5	150	149	141	45.2	45.5	48.1							
Nov. 7	Leeds to Skipton .. 9=12½	207.5	110.9	318.4	Leeds to Ais Gill 64.65	4	93	93	90	41.7	41.7	43	32.6	.127	3200	8.6	10.5	Ditto	Stopped at Blea Moor and Lazonby. Heavy side wind.
	Hellifield to Carlisle .. 6= 8	141.9	106.3	248.2	Ais Gill to Carlisle .. 48.387	1	57	54	51	50.9	53.7	56.8							
	Leeds to Carlisle	149.6	105.7	255.3	Leeds to Carlisle.. .. 113.037	5	150	147	141	45.2	46.1	48.1							
								Mean for above six trips.											
..	.. ..	157.37	105.51	262.88	Leeds to Carlisle .. 113.037	..	150	146.87	139.87	45.2	46.1	48.4	33.9	.128	3256	8.48	10.34		
1.28 P.M., LEEDS TO CARLISLE.																			
Oct. 23 ..	Leeds to Carlisle .. 10=15½	259.3	104.5	363.8	Leeds to Ais Gill 64.65	1	86	84.25	82.25	45.1	46	47.1	43.3	.119	3630	7.4	9.02	Manvers Main	Light wind.
					Ais Gill to Carlisle .. 48.387	..	48	45	45	60.6	64.5	64.5							
					Leeds to Carlisle 113.037	1	134	129.25	127.25	50.5	52.4	53.2							
Oct. 24 ..	Leeds to Carlisle .. 10=15½	258.7	104.1	362.8	Leeds to Ais Gill 64.65	1	86	86	85	45.1	45.1	45.6	46.7	.129	3770	7.14	8.7	Ditto	Heavy side wind.
					Ais Gill to Carlisle .. 48.387	..	48	43	43	60.5	67.4	67.4							
					Leeds to Carlisle 113.037	1	134	129	128	50.5	52.5	52.9							
Nov. 1 ..	Leeds to Carlisle .. 9=14½	245	103.6	348.6	Leeds to Ais Gill.. .. 64.65	1	86	84	..	45.1	46.1	..	44.8	.128	3990	7.87	9.6	Ditto	Heavy side and head wind.
					Ais Gill to Carlisle .. 48.387	..	48	47	..	60.5	61.6	..							
					Leeds to Carlisle.. .. 113.037	1	134	131	..	50.5	51.7	..							
Nov. 3 ..	Leeds to Carlisle .. 9=14½	245.6	104	349.6	Leeds to Ais Gill.. .. 64.65	1	86	85	..	45.1	45.6	..	46.7	.133	3790	7.17	8.74	Ditto	Light side wind.
					Ais Gill to Carlisle .. 48.387	..	48	44	..	60.6	66	..							
					Leeds to Carlisle.. .. 113.037	1	134	129	..	50.5	52.5	..							
Nov. 8 ..	Leeds to Carlisle .. 9=14½	244.6	104.6	349.2	Leeds to Ais Gill.. .. 64.65	1	86	84	82	45.1	46.1	47.3	46.2	.132	3710	7.1	8.66	Ditto	Heavy rain; light wind.
					Ais Gill to Carlisle .. 48.387	..	48	48	48	60.5	60.5	60.5							
					Leeds to Carlisle.. .. 113.037	1	134	132	130	50.5	51.3	52.1							
								Mean for above five trips.											
..	..	250.64	104.16	354.8	Leeds to Carlisle.. .. 113.037	..	134	130.65	129.05	50.5	52.08	52.48	45.5	.128	3778	7.33	8.94		

TABLE I. (*continued*).—PARTICULARS OF WORKING OF COMPOUND ENGINE "No. 2631."

DATE.	VEHICLES.	WEIGHT. Mean of Coaches, Passengers, and Luggage.	WEIGHT. Engine and Mean of Tender.	WEIGHT. Mean of Train, Total.	SECTION OF LINE AND LENGTH.	Number of Intermediate Stops and Starts.	RUNNING TIMES. Booked.	RUNNING TIMES. Actual. Delays by Signals and Special Stops. Included.	RUNNING TIMES. Actual. Delays by Signals and Special Stops. Deducted.	RUNNING SPEEDS. Booked.	RUNNING SPEEDS. Actual. Delays by Signals and Special Stops. Included.	RUNNING SPEEDS. Actual. Delays by Signals and Special Stops. Deducted.	COAL CONSUMED. Per Mile.	COAL CONSUMED. Per Mile per Ton of Mean Total Weight.	WATER EVAPORATED. Total.	WATER EVAPORATED. Per Pound of Coal.	WATER EVAPORATED. Per Pound of Coal from and at 212 deg. Fahr.	REMARKS. *Re* COAL.	REMARKS. GENERAL.
		tons	tons	tons	miles		min.	min.	min.	miles per hour	miles per hour	miles per hour	lb.	lb.	gals.	lb.	lb.		
3.55 P.M., CARLISLE TO LEEDS.																			
Sept. 16 ..	Carlisle to Leeds .. 6=10½	173.69	107.2	280.89	Carlisle to Blea Moor .. 59.55	..	79	63	68	45.2	52.5	52.5	..	..	..	..	..	Particulars of coal and water consumption not taken on this date	Stopped by signals five times between Hellifield and Leeds.
					Blea Moor to Leeds .. 53.487	5	61	67	49	52.6	47.6	65.4							
					Carlisle to Leeds 113.037	5	140	135	117	48.4	50.1	58							
Oct. 17 ..	Carlisle to Leeds .. 5= 9	145.9	108.3	254.2	Carlisle to Blea Moor .. 59.55	..	79	75	75	45.2	47.6	47.6	-28.2	.111	2550	8	9.76	Manvers, 40 per cent.; Featherstone, 60 per cent.	Fine. Light wind. Checked by signals between Hellifield and Leeds
					Blea Moor to Leeds .. 53.487	..	61	64	61	52.6	50.1	52.6							
					Carlisle to Leeds 113.037	.	140	139	136	48.4	48.7	49.9							
Oct. 18 ..	Carlisle to Leeds .. 5= 9	145.9	107.1	253	Carlisle to Blea Moor .. 59.55	..	79	74	74	45.2	48.2	48.2	-27.3	.108	2885	9.35	11.4	Manvers, 35½ per cent.; Featherstone, 64½ per cent.	Fine. Light side wind. Checked by signals between Hellifield and Leeds.
					Blea Moor to Leeds .. 53.487	..	61	63	61	52.6	50.9	52.6							
					Carlisle to Leeds 113.037	..	140	137	135	48.4	49.5	50.1							
Oct. 27 ..	Carlisle to Leeds .. 6=10½	178.8	108.4	287.2	Carlisle to Blea Moor .. 59.55	..	79	77	77	45.2	46.4	46.4	-23.4	.08	2750	10.4	12.6	Manvers, 30 per cent.; Featherstone, 70 per cent.	Fine. Checked by signals between Hellifield and Leeds.
					Blea Moor to Leeds .. 53.487	..	61	63	61	52.6	50.9	52.6							
					Carlisle to Leeds 113.037	..	140	140	138	48.4	48.4	49.1							
Oct. 29 ..	Carlisle to Leeds .. 5= 9	150.8	108	258.8	Carlisle to Blea Moor .. 59.55	..	79	75	75	45.2	47.6	47.6	-22.3	.08	2650	10.5	12.8	Manvers, 15½ per cent.; Featherstone, 84½ per cent.	Rain. Medium side wind. Checked by signals between Hellifield and Leeds.
					Blea Moor to Leeds .. 53.487	..	61	63	60	52.6	50.9	53.4							
					Carlisle to Leeds 113.037	..	140	138	135	48.4	49.1	50.1							
Oct. 30 ..	Carlisle to Leeds .. 5= 9	145.9	108.3	254.2	Carlisle to Blea Moor .. 59.55	..	79	73	73	45.2	48.9	48.9	-24.82	.09	2470	8.8	10.7	Manvers, 19 per cent.; Featherstone, 81 per cent.	Fine. Checked by signals between Hellifield and Leeds.
					Blea Moor to Leeds .. 53.487	..	61	65	61	52.6	49.3	52.6							
					Carlisle to Leeds 113.037	..	140	138	134	48.4	49.1	50.6							
Nov. 7 ..	Carlisle to Leeds .. 5= 9	148.6	106.4	255	Carlisle to Blea Moor .. 59.55	..	79	75	73	45.2	47.6	48.9	-26.5	.104	2930	9.7	11.8	Manvers, 18 per cent.; Featherstone, 82 per cent.	Heavy side and head wind. Checked by signals between Hellifield and Leeds.
					Blea Moor to Leeds .. 53.487	..	61	64	61	52.6	50.1	52.6							
					Carlisle to Leeds 113.037	..	140	139	134	48.4	48.7	50.6							
					Mean of all above trips for times and speeds, and of six trips for coal and water.														
..	.. ..	152.65	107.75	260.4	Carlisle to Leeds 113.037	..	140	138	132.7	48.4	49.08	51.2	25.42	.095	2705	9.45	11.5		

TABLE II.—PARTICULARS OF RUNS.—TRAIN, SPEED, LINE, AND DATE.

—	—	Leeds to Skipton.	Skipton to Hellifield.	Hellifield to Ais Gill.	Ais Gill to Appleby.	Appleby to Carlisle.	Totals.
10.6 a.m. Aug. 21, 1902	Miles	26.187	10.013	28.45	17.587	30.8	113.037
	Coaches, passengers & luggage } Weight	300.3 tons	111.6 tons	..	239.85 tons		
	Total	410.2 ,,	220.28 ,,	..	344.05 ,,		
	Length of train	..	271.5 ft.	..	518.3 ft.		
	Number of axles	..	24	44	43		
	Time	44 min.	17 min.	38 min. 75 sec.	58 min. 25 sec.*		2 hrs. 38 min.
	Speed	35.7	35.3	44	49.8		42.9
5.33 p.m. Sept. 5, 1902	Miles	26.187	10.013	28.45	17.587	30.8	113.037
	Coaches, passengers, & luggage } Weight	282.72 tons		..	229.2 tons		
	Total	392.22 ,,		..	334 ,,		
	Length of train			..	485.1 ft.		
	Number of axles		45		43		
	Time	..		37 min.	15 min.	27 min.	
	Speed	..		46.1	70.3	68.4	58.38
10 a.m. Oct. 12, 1902	Miles	26.187	10.013	28.45	17.587	30.8	113.037
	Coaches .. .. } Weight	..	..	248 tons	..	..	248 tons
	Total	..	..	352 ,,	..	..	352 ,,
	Length of train	..	..	614.8 ft.	..	..	614.8 ft.
	Number of axles	..	..	52	..	..	52
	Time	33 mn. 15 sec.†	12 m. 35 sec.	42 m. 43 sec.	15 m. 10 sec.	26 min. 17 sec.	2 hrs. 10 min.
	Speed	47.2	48	40	69.6	70.3	52.15

* Including signal delays and special stop at Lazonby.
† Including 3½ minutes' delay running slow, taking on and putting down pilot man at Leeds.

TABLE III.—PARTICULARS OF RUNS.—TRAIN, SPEED, LINE, AND DATE.

—	—	Carlisle to Ormside.	Ormside to Ais Gill.	Ais Gill to Blea Moor.	Blea Moor to Hellifield.	Hellifield to Skipton.	Skipton to Leeds.	Totals.
3.55 p.m., Aug. 21, 1902	Miles	33.287	15.1	11.163	17.287	10.013	26.187	113.037
	Coaches, passengers, & luggage } Weight	..	..	..	173.69 tons	..	..	173.69 tons
	Total	..	..	..	280.89 ,,	..	..	280.89 ,,
	Length of train	..	..	..	378.8 ft.	..	..	378.8 ft.
	Number of axles	..	..	..	35	..	..	35
	Time	37 min.	24 min.	10 min.	17 min.	12 min.	31 min.	2 hrs. 11 min.
	Speed	54	37.8	66.9	60.9	50	50.6	51.7
3.55 p.m., Sept. 16, 1902	Miles	33.287	15.1	11.163	17.287	10.013	26.187	113.037
	Coaches, passengers, & luggage } Weight	..	..	..	173.69 tons	..	..	173.69 tons
	Total	..	..	..	280.89 ,,	..	..	280 89 ,,
	Length of train	..	..	..	378.8 ft.	..	..	378.8 ft.
	Number of axles	..	..	..	35			35
	Time	36 min.	21 min.	11 min.	13 min. †	(Carlisle to Hellifield, 81 min.)		
	Speed	55.4	43.1	60.8	79.7	(Average speed, 56.9)		
4 p.m., Oct. 12, 1902	Miles	33.287	15.1	11.163	17.287	10.013	26.187	113.037
	Coaches .. .. } Weight	..	..	..	248 tons	..	..	248 tons
	Total	..	..	..	353.5 ,,	..	..	353.5 ,,
	Length of train	..	..	..	614.8 ft.	..	..	614.8 ft.
	Number of axles	..	..	..	52	..	..	52
	Time	41 m. 40 sec.	23 m. 6 sec.	12 min.	14 m. 34 sec.	9 m. 49 sec.	29 m. 38 sec.	2h.10m. 47 s.
	Speed	48.2	39.2	55.8	71.2	61.3	53.02	51.87

* Including 3 minutes' delay by signals, running slow from Armley into Leeds
† Including time coming to standstill at Hellifield.

CHAPTER 3

THE DEELEY COMPOUNDS

Cecil W. Paget, general superintendent Midland Railway, 1907-1919

Richard Mountford Deeley, chief mechanical engineer Midland Railway, 1904-1909

S. W. Johnson retired at the end of 1903. Although it was generally a time of great change in the railway world the Midland seemed set on a placid enough course. In common with the other trunk lines to the north the loads of the principal express trains were very much on the increase; there were not enough big engines on the road to handle all these, and there was much double-heading. The locomotive management at Derby was well enough aware of this upward trend in loading, and had brought out the large Belpaire 4—4—0s and the compounds; but up to the end of 1903 authority to build either class in any quantity had been grudging, and the impression they had made on the motive power situation as a whole was slight. The brunt of the work still fell upon the Johnson 'Spinners' and the later varieties of the small-boilered Johnson 4—4—0s. South of Leicester and Nottingham the big 'spinners' usually acted as train engines, and the pilots in cases of heavy loading were either 2—4—0s or 4—4—0s.

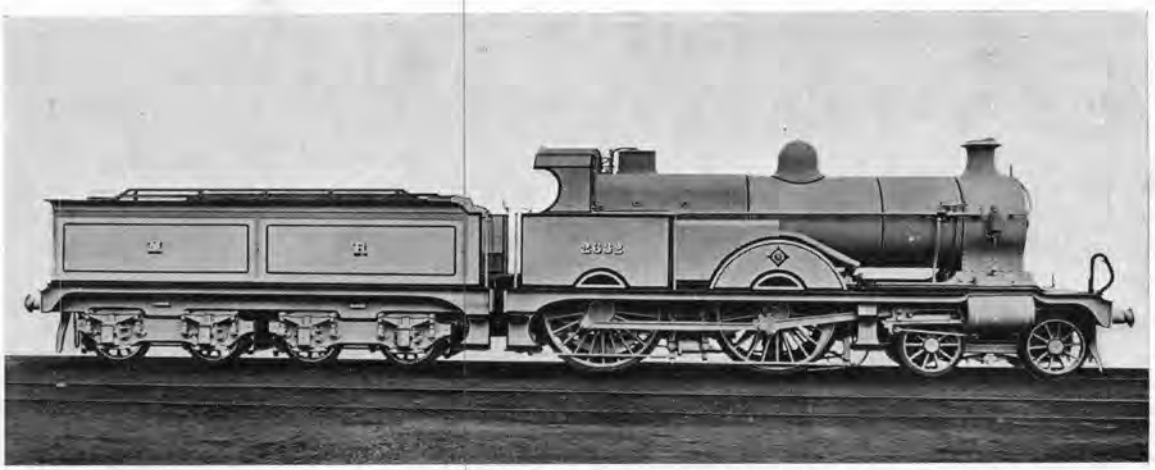
At Derby in the last years of Johnson's long reign there were some strong and brilliant men rising in status and influence. Foremost among these was R. M. Deeley, the Works Manager, who came to understudy Johnson. It is said that Deeley was largely responsible for the radical change in boiler design on the Midland Railway which led to the building of the first 'Belpaires'. Be that as it may, there was no counterpart at Derby to the sad state

of affairs that developed in the last years of William Dean at Swindon, wherein his mental faculties began to fail, and Churchward, with the approval of the Board, gradually took over virtual control. At Derby the second outstanding personality was Cecil W. Paget, Assistant Works Manager, who would have been a colossus in any sphere. It happened also that he was a son of the Chairman of the Company, Sir Ernest Paget, Bart., and despite the seniority of Deeley in the succession, Cecil Paget was freely tipped as the most likely successor to Johnson. The rumours were so persistent that *The Locomotive Magazine* in its issue of September 5, 1903, printed this note:

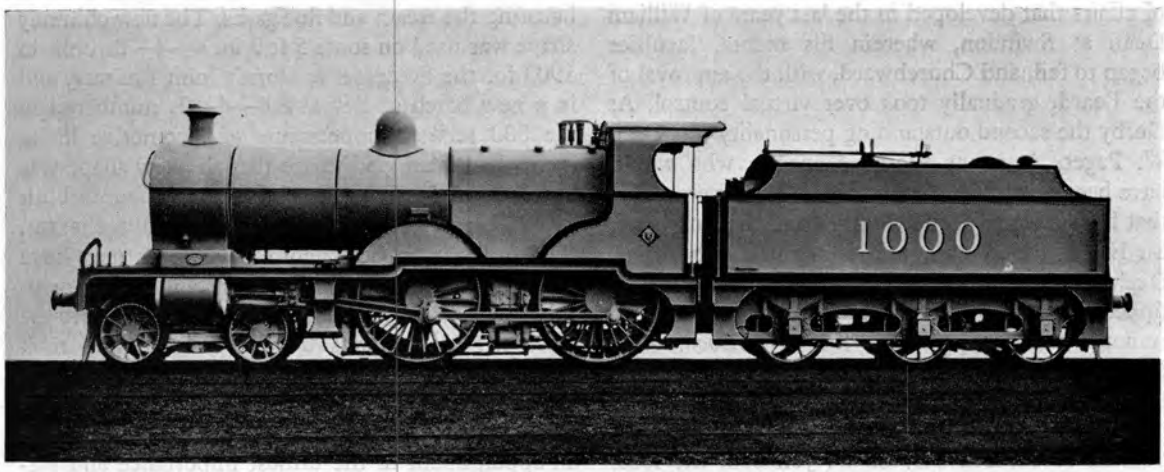
'MIDLAND RY.—Mr. Cecil Paget has been appointed to succeed Mr. S. W. Johnson, the loco. superintendent, who is retiring after 30 years' service with the company. Mr. Johnson was chief of the locomotive, carriage and wagon department of the Great Eastern Ry. from 1866 to 1873, having previously held a similar post on the old Edinburgh and Glasgow Ry.'

Prior even to this there had been other signs of change in the products of Derby Works. In 1903 a new series of 0—6—0 goods engines had been turned out with much larger boilers than the usual Johnson standard; but they included a much less welcome feature to those with eyes for the aesthetic in locomotive design, in the form of a new style of chimney tapering outwards from the base. This of course followed the true functional shape of a locomotive chimney, but hitherto a handsomely curved external profile tapering inwards from the base had encased a liner of the dimensions necessary for exhausting the steam and flue gases. The new chimney shape was used on some 5 ft 9 in. 4—4—0s built in 1903 for the Somerset & Dorset Joint Railway, and in a new batch of Belpaire 4—4—0s numbered in the 800 series. Connoisseurs of locomotive lineaments had been glad to see that the new shape was not used on the three new Johnson compounds built in 1903, and referred to in the previous chapter. But to revert to personalities, whatever may have been the foundation for the persistent reports as to Johnson's successor they proved eventually to be incorrect. Deeley was duly appointed, and took office on New Year's Day 1904.

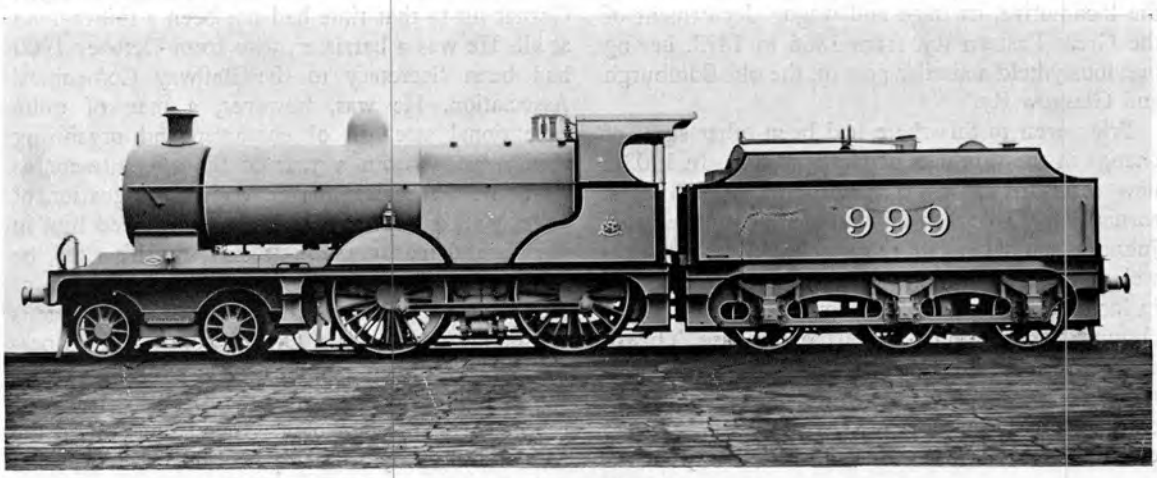
Deeley had been in office a mere eighteen months when the Directors of the Midland Railway made an appointment of the utmost importance and significance in selecting Mr. W. G. Granet to succeed Mr. E. W. Wells as Assistant General Manager. Granet up to that time had not been a railwayman at all. He was a barrister, who from October 1900 had been Secretary to the Railway Companies' Association. He was, however, a man of quite exceptional strength of character and organising ability, and within a year of his appointment as Assistant General Manager, on the resignation of John Mathieson, he was chosen to succeed him in the general managership. It may, by this time, be asked what these changes in the top executive of the Midland Railway had to do with the famous compound locomotives. On the contrary, it is perhaps no more than a slight exaggeration to say that it had *everything* to do with their development—or more strictly the lack of it. Granet reorganised the Midland Railway from top to bottom. It was not



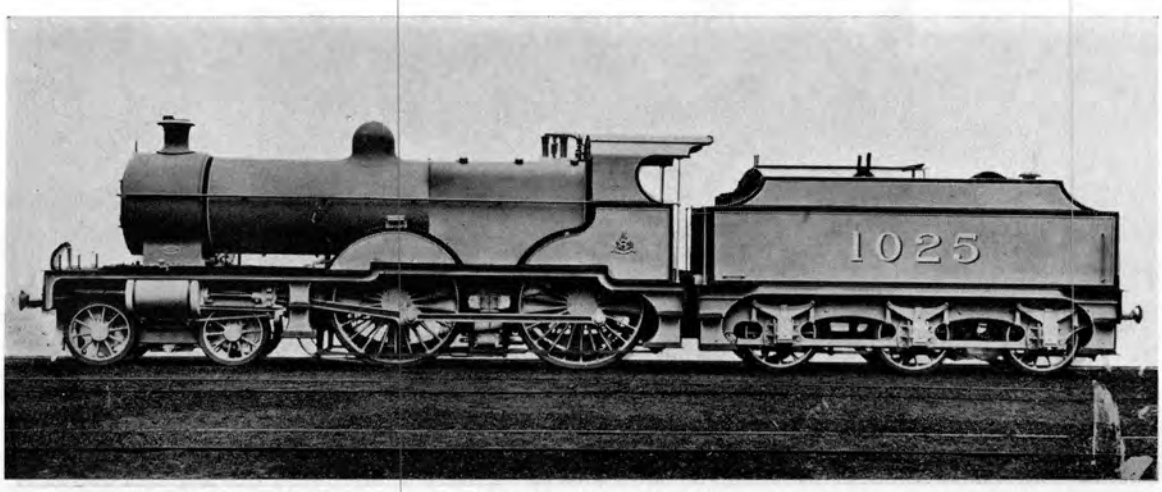
The second of the Johnson compounds, No. 2632



The first Deeley compound, No. 1000, later No. 1005



Deeley's No. 4 Class simple 4-4-0 No. 999 built for comparative purposes



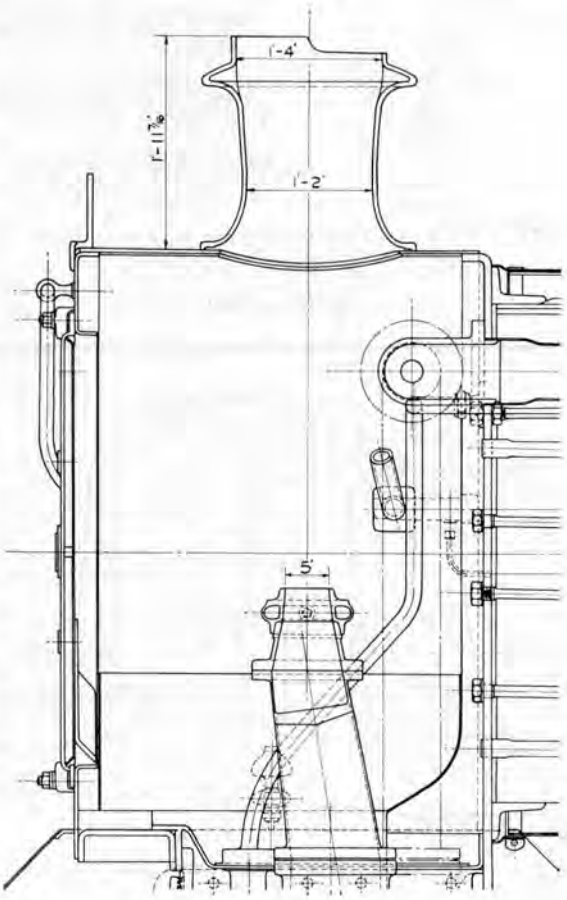
One of the later Deeley compounds, with shallow frames, No. 1025, as built 1906. Later No. 1030

merely a case of creating new appointments, new departments and new alignments; he laid down an entirely new concept of railway management, based on a very strong central control of all activities from headquarters at Derby.

Prior to his coming upon the scene the Midland was organised in much the same way as its rivals to west and to east, and so far as the locomotive department was concerned the Locomotive Superintendent, as his title implied, was responsible for *everything* to do with locomotives, from their design, construction, and repair to the superintendence of their use in traffic. The Locomotive Superintendent worked the trains to the times and schedules laid down by the Superintendent of the Line. And the last-named officer, like his counterparts on other railways, exercised a general supervision over all matters connected with the traffic. Granet created a new office, of what proved to be transcending importance, namely, that of General Superintendent, and to the consternation and annoyance of the locomotive department, the General Superintendent was given responsibility for locomotive running. Cecil Paget was the first holder of this new office, and he took over from his former chief, Deeley, the drivers, firemen, shed staff, and running inspectors from end to end of the line. Deeley was re-designated Chief Mechanical Engineer, and his functions so far as locomotives were concerned were reduced to design, construction and repair, together with such testing and experimental work as was naturally associated with the drawing office at Derby.

Prior to Granet's reorganisation the Smith—Johnson compound design had been subject to an interesting development. It will be recalled that on the third, fourth and fifth engines of the original type, Nos. 2633, 4 and 5, one feature of the Smith system had been dropped, namely, the independent valve gears for the high and low-pressure cylinders. At the close of the year 1905 Deeley turned out a batch of ten new three-cylinder compounds, Nos. 1000-1009, in which there were further differences in the controls. Interest in these new engines was centred, however, mainly upon the striking changes in external appearance that were embodied, including certain features that were to become standard Midland and L.M.S.R. practice for many years after. So far as basic dimensions were concerned the only difference from Nos. 2631-5 lay in the boiler pressure, which was increased from 195 to 220 lb. per sq. in.—a notable increase in nominal tractive power.

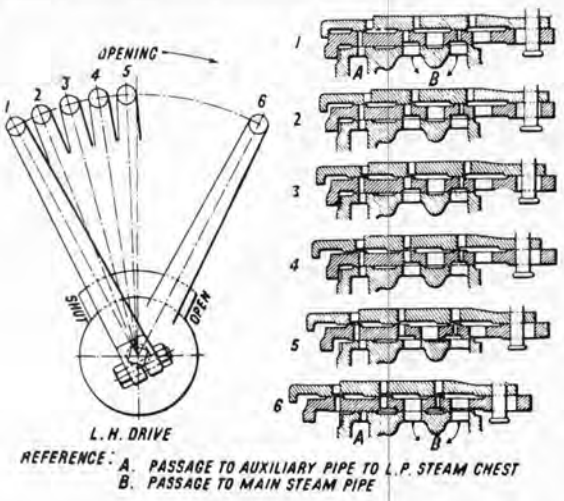
Externally the finish was much plainer than of old. One missed the brass beading over the driving wheel splashers; the safety valves were exposed, instead of concealed in the polished brass casing of the previous batches of large 4—4—0 engines, but on the other hand the handsomely-shaped canopied cab was a distinct improvement on past designs. Those who had been looking rather askance at the deterioration in artistic quality of Midland chimneys since Johnson had departed were to some extent reassured by the sight of a new cast chimney of shapely proportions. Internally it was something of a curiosity, for the liner stopped short above the level of the lower edge of the flange, and the accompanying drawing shows how this left an annular recess at the top. There was some tendency for the exhaust to splay out beyond the top of the liner, and this gave rise to that distinctive 'woof' in the exhaust noise of all Midland engines having the Deeley chimney. Another quite superficial innovation was to carry the engine number on a small cast plate in the middle of the smokebox door. The practice of having a huge number on the tender had



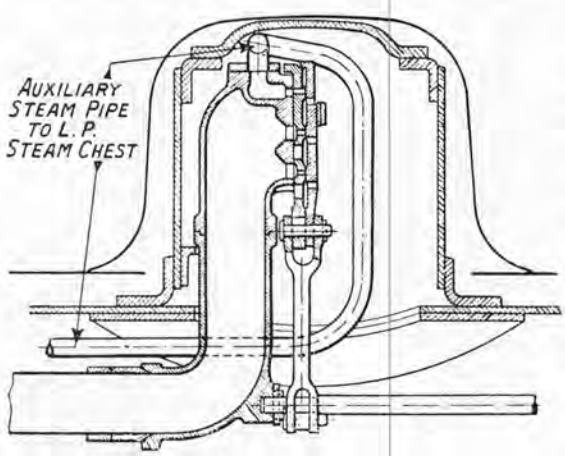
Deeley smokebox and chimney

already appeared on a batch of Belpaire simple 4—4—0s built at Derby not long after Johnson's retirement.

But the really significant change in the new Deeley compounds over their predecessors lay in the manner of starting. The Smith—Johnson controls gave a remarkable degree of flexibility in handling the engine, but they were rather complicated, and tended to be beyond the capacity of an average engineman to manipulate to the best advantage. Instead, Deeley designed an ingenious regulator which gave the driver all the control he needed with a single device that could scarcely have been more simple to operate. The prime necessity in starting a three-cylinder compound which has only one high-pressure cylinder is to be able to admit live steam direct from the boiler to the low-pressure cylinders, and the Deeley regulator is shown diagrammatically in the accompanying drawings. The regulator is situated in the dome, and one must imagine the regulator shown in the lower of the two diagrams as being surrounded by live steam at about 220lb. per sq. in. Chamber B leads direct to the main steam pipe, and so to the high-pressure cylinder, while the small chamber A leads to the low-pressure receiver. The communicating pipe leading away at this point is, however, of relatively small bore. It is carried through the smoke box tube plate and thence down the inside of the smoke box. The main valve, and the jockey valve, seen in the diagrams 1 to 6, are both actuated by the fork-ended link seen in the lower drawing, which is controlled by the regulator handle in the cab.



Deeley regulator



Arrangement of regulator in dome

The hole in the main valve in which the fork-pin works is slotted, while that in the jockey valve is not. In '1' the regulator handle is hard back against its stop and all ports are closed. When the regulator handle is moved to the position shown in '2' only the jockey valve is moved, the pin merely moving through the slotted position of the hole in the main valve. The two small ports are opened by stages in the positions '3', '4' and '5', and live steam is admitted to the low-pressure cylinders via chamber A, and also in very small quantities to the high-pressure cylinder. This gets the engine started, working virtually as a two-cylinder simple, though this part of the working is officially known as semi-compound. Then, when the train has reached a speed of about 10 m.p.h., the regulator handle must be put right over to the full position, as shown in '6'. This brings the large valve ports wide open, and the jockey valve is closed. Full compound working begins.

It may be, however, that the load of the train and the scheduled speed do not require the continuance of full-regulator working once 60 m.p.h. or so is attained, and the driver can then ease the steaming gradually by working his regulator handle back, from '6' towards '5'. It is sometimes thought that this easing might be carried to the extent of re-introducing semi-compound working, but this is not so. Once the regulator has been opened to the full the jockey valve cannot be reopened until the regulator has been completely closed, and then reopened the necessary amount. The working of this regulator could be very quickly mastered, and

in this one device Deeley put into the hands of his drivers a far simpler and more readily actuated means of controlling these compound locomotives. Providing the movements of the regulator were carried out according to rule when starting the driving of a compound was, in Deeley's day, no different from that of a simple. Furthermore, a very little experience was necessary to get the 'feel' of the regulator, and this told the driver more than any actual position on the quadrant plate when the jockey valve was fully open.

The first ten of the new engines were built at Derby in October—December 1905, and apart from the controls and the boiler pressure, there were some differences in the boiler from that of the original Johnson compounds. The most important difference was the increase in grate area from 26 to 28.4 sq. ft. The latter was an exceptionally large grate for the period, particularly on a 4—4—0 engine, and represented a totally different outlook on boiler design, and working from current Crewe practice, when the new 'Precursors' had deep, narrow boxes with a grate area of no more than 22½ sq. ft.

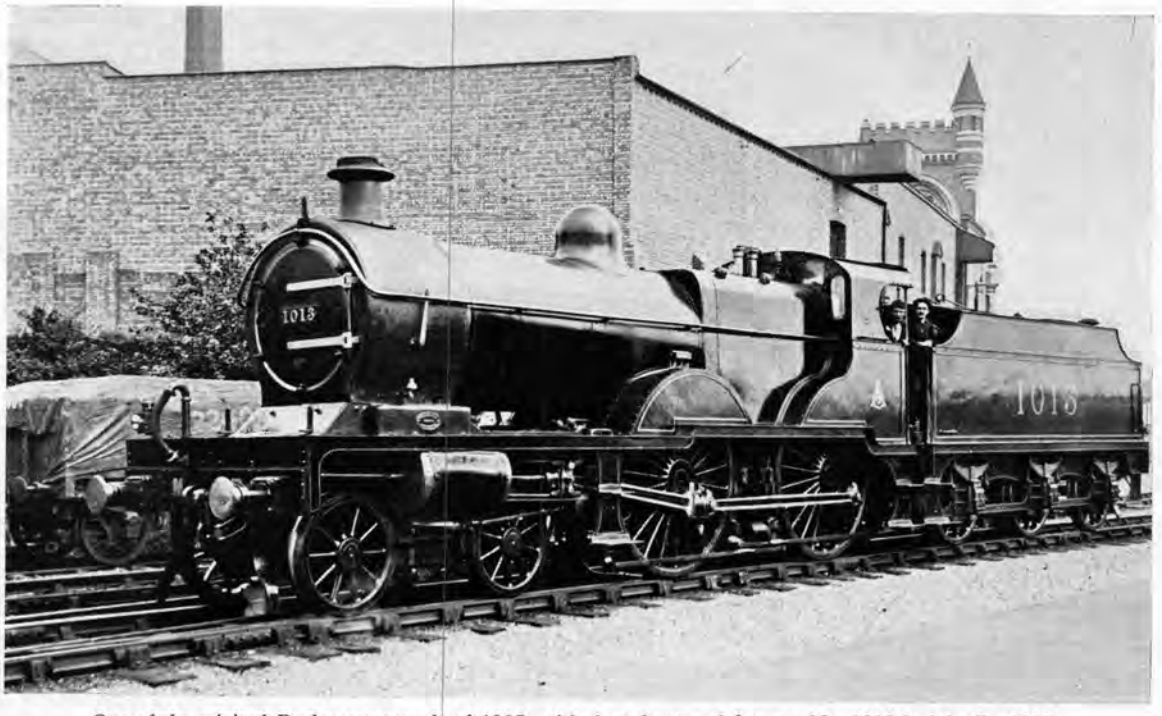
I should add that in the renumbering scheme of 1907, to which reference will be made shortly, No. 2631 became No. 1000, and Deeley's original No. 1000 became 1005.

COMPARATIVE BOILER DIMENSIONS

Engine No.	2631	1000*
Length of barrel	11ft. 7in.	11ft. 11in.
Minimum dia.	4ft. 8in.	4ft. 7⅞in.
Tubes, number	261	216
outside dia.	1¾in.	1⅞in.
Heating surface		
tubes	1448 sq. ft.	1305.5 sq. ft.
firebox	150 sq. ft.	152.8 sq. ft.
total	1598 sq. ft.	1485.3 sq. ft.
Grate Area	26 sq. ft.	28.4 sq. ft.
Boiler Pressure	195 lb per sq. in.	220 lb. per sq. in.

* later No. 1005.

A further batch of 20 of these engines was turned out at Derby between March and December 1906. These were numbered 1010 to 1029, and included one noticeable difference from Nos. 1000-1009. At the front end the frames were made quite shallow instead of being carried upwards to form a support for the smokebox. On Nos. 1000-9 the smokebox was D-shaped at the front like the Johnson com-



One of the original Deeley compounds of 1905, with deep front-end frames, No. 1013 (originally 1008), regular engine of Driver Hailstone of Trafford Park, father of E. Hailstone of 'Silver Link' fame on the Eastern Region of British Railways

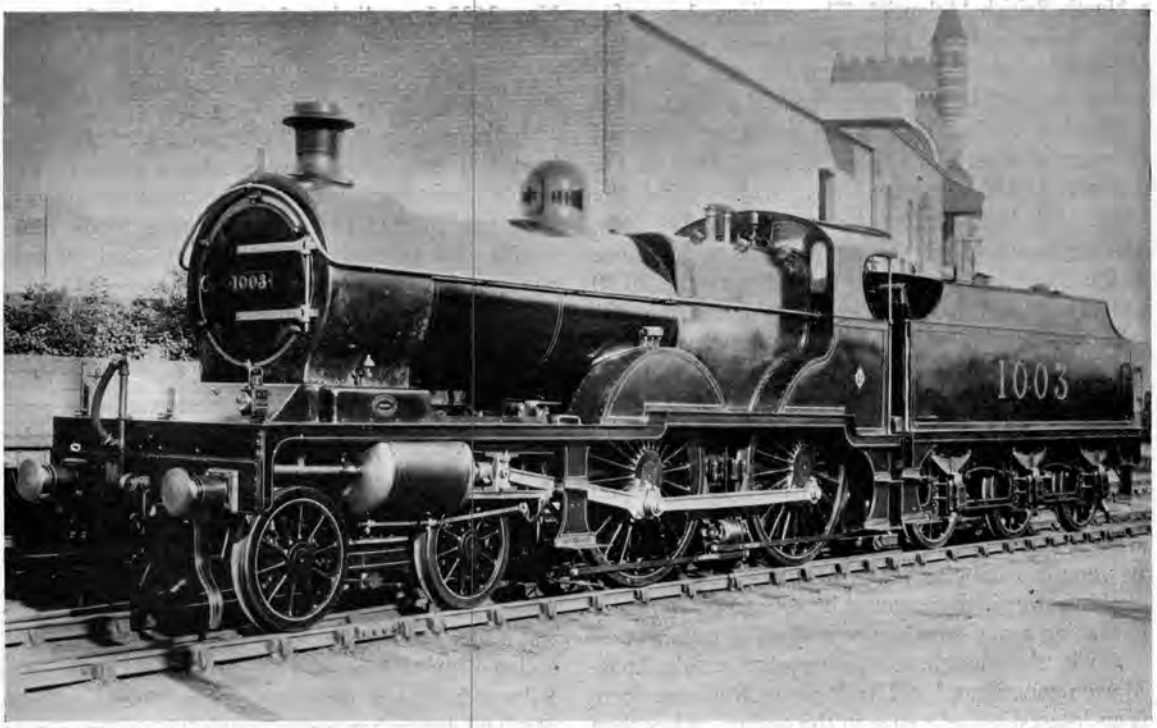
A characteristic picture of one of the later Deeley compounds, in non-superheater days: No. 1031, photographed alongside the brewery at Kentish Town

pounds, whereas in the later engines it was completely circular. Until the renumbering of 1907 many engines of the same class had numbers scattered anywhere between 1 and 2600! Some of the 4—2—2 'spinners' and the small Johnson 4—4—0s were notorious in this respect. But in 1907, to fit in with the general reorganisation in progress throughout the Company's affairs, the entire locomotive stock was renumbered, to bring engines of the same wheel arrangement and power classification into a consecutive series. Thus the 2—4—0s began at 1, the small-boilered 4—4—0s began at 300, the 'spinners' at 600, and so on. The compounds were perhaps the least affected of any, for the original Johnson engines were numbered 1000 to 1004, and the Deeley engines each added five to their numbers, 1000 becoming 1005, and so on.

The reorganisation came to mean much more to the locomotive department than the mere renumbering of the entire stock. The divorcing of the responsibility for running from the Chief Mechanical Engineer led to a reconsideration of the means of regulating train loads. The traffic authorities who took over this responsibility were not expected to be able to distinguish between the merits of one individual engine of a class or another. If a particular train was booked for a No. 3 class engine, any engine of that class that could turn a wheel was expected to be able to do the job, whatever its condition or mileage since last general overhaul.

In consequence the loads for each power class were fixed well below the maximum capacity of that class when in good condition. In passing, it may be mentioned that No. 1 class included all the 2—4—0s, 4—2—2s, and the small-boilered Johnson 4—4—0s; No. 2 class included the Johnson 4—4—0s rebuilt with larger boilers; No. 3 class contained only one engine design, the 'Belpaire' 4—4—0s, while No. 4 class consisted of the compounds and Deeley's large 6 ft. 6 in. simple 4—4—0s of the '999' class. The express trains were graded according to schedule, the great majority south of Leeds coming within the 'Special Limit' category. On a 'Special Limit' train the maximum load for a No. 4 class engine was 230 tons. The corresponding limits for Class 2 and Class 3 engines were 180 and 205 tons respectively.

Of course the 'Special Limit' trains were mostly quite sharply timed, with bookings like 105 min. for the 99 miles from Leicester to St. Pancras. Nevertheless to a compound in good nick, they were child's play. And with this rigid limitation of load there descended an equally rigid control. The slightest excess over the maximum tonnages laid down called forth a pilot engine, and the Control organisation set up by Cecil Paget became extremely efficient in producing pilots at short notice, when required. At the same time the control methods began to take a great deal of the individuality out of express train running. It was extremely rare that



One of the most famous of all Midland compounds in its earliest form. This engine, seen here as No. 1003, as built in 1905, became No. 1008, and represented the Midland in the celebrated Leeds—Carlisle trials of 1923-4

any driver was called upon to cope, in emergency, with an exceptional load unaided, and in consequence the great promise shown by the Johnson compounds as haulers of heavy loads was not borne out in the nominally more powerful Deeley compounds. Contemporary observers got the impression that they were sluggish, whereas in actual fact, with the light loads put behind them they climbed the banks so smartly that drivers got into the habit of shutting off steam entirely downhill, and not exceeding 70 m.p.h. or so.

In 1901 Charles Rous-Marten had inaugurated the series of articles, 'British Locomotive Practice and Performance', in *The Railway Magazine,* and from its inception that series has proved a weather-vane of popular interest in locomotive working of the day. The Johnson compounds came in for a fair share of attention in their early days, when it seemed clear that despite his impartiality Rous-Marten had a distinctly warm place in his breast for the Midland Railway. It is all the more remarkable, therefore, that after the construction of the first Deeley compounds in 1905, which Rous-Marten immediately predicted would be still better than the Johnson engines, one can find no more than incidental references to their performance; indeed Rous-Marten died, in April 1908, without having published details of a single run with one of them. Moreover, R. E. Charlewood continued the series for a time, and he was followed by a triple-headed authorship in which J. F. Gairns, the Rev. W. J. Scott, and Cecil J. Allen each contributed once every three months; and it was not until Cecil J. Allen had been the sole author for more than a year, in April 1912 to be precise, that at last some details of the work of the Deeley compounds appeared in *The Railway Magazine.* Then, out of thirteen runs detailed in tabular form there was no case of a gross load exceeding 240 tons.

One of the most interesting events in the early history of the Deeley compounds was recorded briefly by R. E. Charlewood in 1908. One gathers that the management of the North British Railway was not entirely satisfied with the working of W. P. Reid's big 'Atlantics'. One of them was tested against a North Western 'Experiment' class 4—6—0 between Preston and Carlisle, and then arrangements were made for two different types of compound to work over the Waverley Route between Carlisle and Edinburgh, turn and turn about with

a North British 'Atlantic'. The engines chosen for trial were a Smith four-cylinder compound 'Atlantic' of the North Eastern Railway, No. 731, and a standard Deeley compound, No. 1032.

The load limits over this line were then stipulated in 'pairs of wheels', and the 'Atlantic' limit on the Anglo-Scottish expresses was '42½'. With the M. & N.B. Joint Stock this meant about 240 tons. The trains on which the comparative performance of the three engines was examined were the 10.30 a.m. ex-Waverley, allowed 156 min. for the 98¼ miles to Carlisle, with four intermediate stops, and the 3.55 p.m. down, non-stop in 135 min. It was reported that the Midland compound No. 1032 kept time comfortably, with maximum load, despite having to make an intermediate stop for water on the down journey. This is really no reflection upon the design of the locomotive. The Waverley Route is an extremely awkward one for a stranger to learn, and one can imagine that with more experience of working over it there would have been no difficulty in making a non-stop run over the 98¼ miles.

Curiously enough, in the very last article Rous-Marten contributed to *The Railway Magazine* there is an interesting reference to the design, rather than the performance of the Midland compounds. Rous-Marten had referred to the engines of 1905 and onwards as 'Smith compounds', having obtained information from a source that he considered as reliable that No. 1000 and her kin were the same as the 2631-5 batch, except for the raising of the boiler pressure. Already Johnson himself had made a significant change in the valve gear controls on Nos. 2633-5, as distinct from that on the first two, and following Rous-Marten's reference to No. 1000 as a 'Smith compound', Deeley himself wrote to correct him thus:

'There are no "Smith" compounds on the Midland Railway. They have all been altered. The Smith reducing valve arrangement frequently failed, so I fitted the engines with a much more simple starting arrangement.' The original Johnson engines, in addition to being renumbered, were fitted with Deeley chimneys and six-wheeled tenders, though their rectangular rear splashers, short cabs, and lock-up safety valve columns remained until they were rebuilt with superheater.

Turning to actual performance of the Deeley engines, in their original conditions, I have chosen three typical runs for detailed tabulation, all of which were clocked by Mr. Cecil J. Allen. The first run was on the 12.25 p.m. up from Leicester, with No. 1013, and involved some very good uphill work. After the usual easing round Wigston curve there was a fine acceleration to 57½ m.p.h. at Great Glen, and the initial time of 13¼ min. from Leicester to Kibworth was a very smart one. Wherever else Midland drivers ran easily downhill it always seemed traditional to indulge in no restraint descending from Kibworth to Market Harborough, and on this run, sure enough, the driver of No. 1013 allowed his engine to accelerate like lightning to attain the maximum speed of the journey on this relatively short descent. They passed East Langton at 77½ m.p.h. Speed was sustained at 45 m.p.h. up the 1 in 132 of Desborough bank, but descending to

Engine No. 1007 on down Scotch express passing Ilkeston Junction

Engine No. 1016 on up express at Loughborough troughs

Edinburgh—St. Pancras express leaving Carlisle hauled by No. 1009, piloted by Class 2 4-4-0 No. 431

Kettering steam was shut off and the brakes applied slightly. Similarly after an excellent climb from Irchester to Sharnbrook summit, with a minimum speed of 46 m.p.h. on 3 miles of 1 in 119, steam was shut off descending towards Bedford. On the long climb to Leagrave summit (at milepost 34) mostly on 1 in 200, the minimum speed was 51½ m.p.h. The run was entirely undelayed, and there was a gain of 3¼ min. on schedule time.

Table II brings us to a run that would be considered a novelty today, namely, a non-stop run from Leeds to St. Pancras, scheduled in 3 hr. 35 min., made moreover with an express off the Waverley route. In these days it is interesting to reflect that prior to World War I there was sufficient traffic to justify running the 10.30 a.m. from Edinburgh as a separate train throughout from Carlisle during the summer months, and giving it such preferential treatment south of Leeds. Engine No. 1011 had a typical task for a Midland compound in those days. The line north of Trent was not so beset with colliery subsidence checks as it has since become, and on one occasion Cecil J. Allen recorded a run with this same train on which Leeds was left 5 min. late, and Trent passed a minute early, in 83 min., for this distance of 76 miles. This was achieved by one of the Johnson series of compounds and a load of 240 tons. On the run tabulated No. 1011 did as well, if not slightly better, as far as Chesterfield, but then came down the Erewash Valley without steam, and had not recovered the effects of the signal check by the time Trent was passed. The 99 miles from Leicester to St. Pancras

Down Scotch express in the Erewash valley hauled by No. 1008

were then covered in 104 min. 5 sec., despite a bad signal check at Luton, and the train arrived less than a minute late.

At one time the compounds were concentrated at no more than three sheds on the Midland Railway, namely, Kentish Town, Trafford Park and Leeds, and in working the London—Manchester expresses engines were changed at Leicester. There was good reason for doing this, because the crack expresses ran non-stop from Cheadle Heath to Leicester *via* the Derby avoiding line. The two runs detailed in Table III, which show closely similar work on the ascent to Peak Forest, were on the 12 noon express from Manchester allowed 101 min. for the 82.2 miles from Cheadle Heath to Leicester. The first of them has a further interest in that the regular driver of No. 1013 was Hailstone, a well-known Trafford Park driver of those days. One of his sons is no doubt better known to present-day students of locomotive performance, for he was the regular driver of the Gresley streamlined Pacific *Silver Link*. Yet another was an express driver at Westbury G.W.R. Referring now to Table III both runs showed a considerable loss of time on the sectional booking to Chinley. At the same time an allowance of 18 min. was certainly optimistic seeing that for except for three-quarters of a mile of level track at the southern end of Disley Tunnel, and half a mile of 1 in 200 near Hazel Grove, the ascent varies between 1 in 90 and 1 in 140 throughout. The Midland drivers of old were quite consistent in the amount of time they dropped between Cheadle and Chinley, knowing that at least 3 min. recovery time was available to them in the negotiation of the Derby avoiding line. Over the 8.7 miles from Derby North Junction to Sheet Stores Junction they regularly took about ten minutes instead of the 13 min. scheduled.

Although they lost time in the process Driver Hailstone on No. 1013, and Driver Sykes on No. 1012, were doing splendid work uphill between Hazel Grove and Peak Forest, and their average speeds of 35 m.p.h. and over were sustained against a gradient averaging 1 in 107 throughout. The occurrence intermediately of the two long tunnels must be emphasised; Dove Holes, in particular, is a thoroughly nasty place through the limestone of the Peak, on a gradient of 1 in 90. Yet in both cases speed never fell below 30 m.p.h. on the climb. One never pays much attention to the downhill running over this route, because the constant succession of curves precludes anything in the way of sustained high speed. Seen from the footplate, of course, it is one of the most thrilling stretches of line imagin-

TABLE I

12.25 p.m. LEICESTER—ST. PANCRAS
Load: 215 tons gross
Engine: 3-cylinder compound No. 1013

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	LEICESTER . .	0	0 00	—
3.7	Wigston . . .		6 10	—
10.2	Kibworth . .		13 15	57½/50
—	East Langton		—	77½
16.2	MARKET HARBORO'		18 25	40 (slack)
21.0	Desborough . .		24 10	45
27.1	KETTERING .	30	30 05	67 (max)
34.1	WELLINGBOROUGH		36 25	—
39.4	*Milepost* 59¾ . .		42 15	46
—	Sharnbrook . .		—	75 (eased)
49.3	BEDFORD . .	52	50 55	—
57.3	Ampthill . .		58 50	
66.3	Leagrave . .		69 10	51½ (min)
68.9	LUTON . .	73	71 35	
79.2	ST. ALBANS .		81 10	
83.9	Radlett . . .		85 35	
86.7	Elstree . . .		88 20	
92.2	Hendon . . .		93 15	
97.6	Kentish Town .		98 40	
99.1	ST. PANCRAS .	105	101 45	

TABLE II

3.40 p.m. LEEDS—ST. PANCRAS
Load: 175 tons gross
Engine: 3-cylinder compound No. 1011

Dist. miles		Sch. min.	Actual m. s.
0.0	Leeds . . .	0	0 00
10.0	Normanton . .		12 50
20.9	Cudworth . . .		25 05
28.9	Swinton . . .		32 20
34.0	Rotherham . . .	39	38 20
41.7	Killamarsh . . .		47 10
—			sigs.
49.8	Chesterfield . .		57 45
57.4	Doe Hill . . .		68 05
62.5	Pye Bridge . .		74 35
69.3	Ilkeston Junction .		82 40
76.2	Trent . . .	89	90 40
84.5	Loughborough . .		99 40
92.3	Syston . . .		106 50
97.0	Leicester . . .	111	111 35
100.7	Wigston . . .		116 35
107.2	Kibworth . . .		123 30
113.2	Market Harborough .		128 45
118.0	Desborough . .		134 55
124.1	Kettering . . .	140	140 35
131.1	Wellingborough . .		146 45
146.3	Bedford . . .	162	161 45
163.3	Leagrave . . .		181 20
—			sigs.
176.2	St. Albans . . .		196 20
183.7	Elstree . . .		202 40
189.2	Hendon . . .		207 20
194.6	Kentish Town . .		212 55
196.1	St. Pancras . .	215	215 40

TABLE III
CHEADLE HEATH—LEICESTER

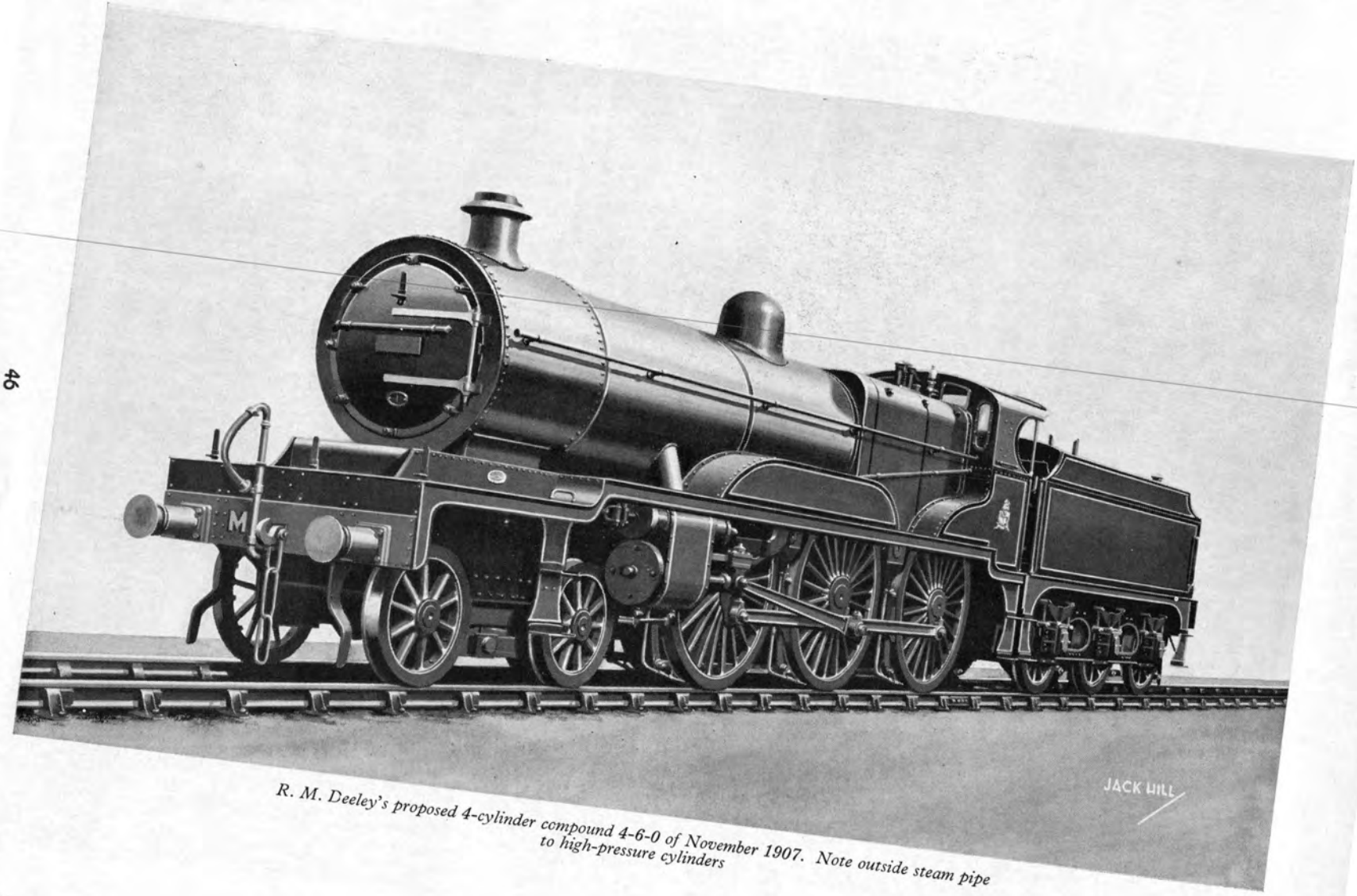
Run No.		1	2
Engine (compound) No.		1013	1012
Load, tons full		215	215

Dist. miles		Sch. min.	Actual m. s.	Actual m. s.
0.0	CHEADLE HEATH	0	0 00	0 00
4.0	Hazel Grove		8 20	8 15
11.8	Chinley	18	20 25	20 55
13.8	Chapel-en-le-Frith		23 50	24 35
17.4	Peak Forest	27	30 55	31 15
22.0	Millers Dale	32	35 40	35 45
31.8	Rowsley	42	45 35	44 45
36.0	Matlock		50 15	49 25
43.1	Ambergate	54	57 45	56 30
52.8	*Derby North Jc.*	66	68 40	67 00
61.5	*Sheet Stores Jc.*	79	78 40	77 05
69.7	Loughborough		87 45	85 40
81.5	Humberstone Road		99 15 sigs.	97 05
82.2	LEICESTER	101	101 00	98 35
	Average speed Hazel Grove—Peak Forest m.p.h.		35.6	35.0
	Min. speed at Peak Forest m.p.h.		32	31

able, with the constant succession of rock cuttings, tunnels and viaducts set amid the majestic limestone scenery of the Peak District. On this line the non-superheater compounds seemed to excel in climbing the heavy gradients, and some of their hardest work was to be witnessed between Derby and Manchester.

Up Manchester express passing High Peak Junction, hauled by No. 1019

Up Manchester express passing Cromford hauled by No. 1021



R. M. Deeley's proposed 4-cylinder compound 4-6-0 of November 1907. Note outside steam pipe to high-pressure cylinders

Among locomotive men the term 'Deeley compound' has never meant more than the range of 45 three-cylinder 4—4—0s of the Midland Railway; but in other circumstances there might have been Deeley compounds of several other types. Deeley himself had a very fertile brain. What other designs he had in mind I cannot say, but two definite proposals were developed in the drawing office at Derby and are included among the official records. There was a 2—4—4—2 tank, and a 4—6—0 express passenger design, both of which had *four* cylinders. Although neither reached the stage of being built, some reference to them is certainly justified in a book entitled *Midland Compounds*. By the courtesy of Mr. A. E. Robson, Chief Mechanical and Electrical Engineer, London Mid-

Glasgow—St. Pancras express leaving Carlisle, hauled by No. 1010

land Region, British Railways, I have been favoured with copies of the original drawings, and from one Mr. Jack Hill has made his drawing. The drawing of the 2—4—4—2 tank is dated 11/12/05 and that of the 4—6—0 26/11/07. It is interesting to note that the drawing of the tank engine is initialled 'J.E.A.'—that is J. E. Anderson—late Superintendent of Motive Power, L.M.S.R. The 4—6—0 drawing is initialled 'S S.'—S. J. Symes, who later became Stores Superintendent of the L.M.S.R., and Acting Mechanical Engineer at one period when Sir William Stanier was away in India.

The 2—4—4—2 tank was an extraordinary affair. The high and low-pressure engines each drove separate and unconnected groups of four-coupled wheels, and while there is nothing inherently unusual in that one questions why the high-pressure cylinders were placed at the rear. This resulted in extremely long steam pipes, outside, from a manifold on the top of the boiler just ahead of the dome. Worse still, perhaps, was the lengthy exhaust from the high-pressure cylinders to the receiver. Both this, and the long pipes from the steam manifold, would have resulted in a considerable drop in pressure during transit. Why the high-pressure cylinders could not have been placed ahead of the coupled wheels they drove is not apparent from the drawing. The boiler was exactly the same as that of the Deeley non-superheated compounds, with 220 lb. pressure, and a grate area of 28.4 sq ft.

But perhaps the greatest peculiarity of this curious locomotive was to have the two groups of coupled wheels uncoupled to each other. In the year of grace 1905 one would have thought that memories of the Webb three-cylinder compounds on the L. & N.W.R. would be too fresh for any engine designer to design a compound locomotive, and have the high and low-pressure cylinders driving separate and uncoupled sets of wheels. It is true that in the Midland case the cylinders were driving four-coupled groups, rather than "single drivers', as in the Webb case. But there would be just the same lack of synchronisation, and one four-coupled engine was just as liable to slip as any other. Furthermore, with the Deeley regulator, when the locomotive was starting the rear group of coupled wheels would not be driven, and would inevitably provide some resistance. It is perhaps a little unfair to criticise an engine that never reached the stage of production; but taken as no more than a project it does seem a most curious one.

The express passenger 4—6—0 of 1907 is certainly a much more intriguing proposition. In putting forward proposals for a 4—6—0 locomotive

weighing 76 tons without its tender, and having a nominal tractive effort of 25,700 lb., in 1907 Deeley was striding well ahead of his East Coast and West Coast rivals, and matching the very latest engines of the Great Western. And it is most interesting to see that he was proposing to use the de Glehn rather than the Smith arrangement of cylinders. The boiler was to have been an enlargement of the three-cylinder 4—4—0 type, providing a total heating surface of 1,970 sq. ft., with a grate area of 30 sq. ft. Piston valves of $8\frac{3}{4}$ in. diameter were to have been used throughout, while the valve gear was that of the 'scissors' type introduced on the '999' class 4—4—0s that came out in 1907. These engines, and the furore that developed around their valve gear, are referred to in the next chapter. With the 'scissors' gear only two sets were needed to actuate the valves of all four cylinders, those of the outside cylinders being driven through transverse rocking shafts. This arrangement was an almost exact counterpart of that used on the pioneer Great Western four-cylinder simple 4—4—2, the *North Star,* built at Swindon in 1906.

This 4—6—0 design provides a most important link in the history of Midland locomotives. It shows that Deeley himself was prepared to put the Midland in the forefront of British locomotive development, and to tackle big loads on the new 'Special Limit' timings. There is no reason to suppose that these 4—6—0s would not have been as great a success as the three-cylinder compound 4—4—0s, and if the management had invested in 40 or 50 of them, it would be quite an exercise to work out how much might have been saved in the ensuing years by the elimination of a great deal of double-heading. It is, of course, always a costly business to introduce a new engine design, with the capital outlay for new patterns, flanging blocks, and so on; but in view of the vast amount of double-heading that became necessary in later years, through inadequate engine power, the outlay would seem to have been well worth while. Again, imagine what a different situation would have existed in 1923 had the Midland entered the L.M.S. group with a stud of powerful four-cylinder compound 4—6—0s, capable, most likely, of eclipsing the 'Claughtons' and L. & Y. Class 8 4—6—0s in every respect. In such circumstances Deeley might still have been in office and the famous stillborn compound Pacific of 1926 would have been a natural and acceptable development.

These thoughts spring inevitably to mind as one studies the drawing of Deeley's four-cylinder compound 4—6—0 of 1907. Other influences killed this notable project stone dead, and Derby locomotive development, from entering the new century so full of enterprise and enthusiasm, was forced back upon a period of scientific mediocrity.

Down Anglo-Scottish express leaving Elstree Tunnel, hauled by No. 1042 piloted by a 7ft. 9in. single, No. 672

CHAPTER 4

COMPARISONS AND TESTS: THE INTRODUCTION OF SUPERHEATING

Richard Mountford Deeley was nothing if not an inventor and experimenter, and having taken the Midland Railway Company's best engine, and changed its controls from rather an elaborate 'box of tricks' into something very simple, consolidated the position by putting thirty engines of the improved and simplified design on the road, and had an embargo placed upon his proposals for a much larger compound, it would seem that he sat back and wondered if, after all, compounds were the best form of locomotive for the traffic of the day. By the time the second batch of Deeley compounds were taking the road the pattern of Midland train operating had changed. It was no longer necessary to provide for the haulage of heavy trains; the policy was one of light trains and many of them, while at the same time very little money was forthcoming for new construction. Rebuilding of the old Johnson 4—4—0s was in progress, but this process merely stepped up their capacity from Class 1 to Class 2. A three-cylinder compound, albeit one so simple in its design as Deeley's, inevitably costs more to build than a simple engine of equal capacity, and it was to compare the merits of compound and simple propulsion, on equal terms, that led to the construction of the '999' class 4—4—0s in 1907.

These handsome engines, of which ten were built, had the same boiler and firebox as the compounds, except that by a rearrangement of the tubes an additional 99 sq. ft. of heating surface was provided. These engines had 249 tubes $1\frac{3}{4}$ in. outside diameter, against 216 tubes of $1\frac{7}{8}$ in. outside diameter, on the compounds. The cylinders were 19 in. diameter by 26 in. stroke, and the coupled wheels were 6 ft. 6 in. diameter. But in one respect, that might conceivably have proved a factor completely outweighing any difference between compound and simple expansion, the Deeley compounds and the '999' class simples differed considerably.

The compounds had Stephenson's link motion, with short lap valves, while the '999' class had the controversial 'scissors' gear. The history of this latter gear is worth recalling, because it throws an interesting sidelight upon Deeley's character. As the size and power of locomotives increased so the space between the frames became more restricted; and since British designers still favoured the use of inside cylinders much thought was given in some drawing offices as to how space could be saved. It so happened that an arrangement of a valve gear requiring no eccentrics at all had been used in Belgium, and in two known instances in the U.S.A.; and at the same time, when he was Works Manager at Derby, Deeley worked out an arrangement of his own on somewhat similar lines.

At the time Johnson would have none of it; but when he succeeded to the chair Deeley filed an application for patent in respect of this device, in 1905. Imagine then his consternation when the pioneer Great Western four-cylinder simple express locomotive No. 40, *North Star*, appeared in 1906 fitted with such a close adaptation of his scissors gear as to look like a straight copy! Deeley was furious, and immediately wrote off to Churchward threatening all sorts of dire consequences for the G.W.R. Of course, Churchward was not the man to wilt in the face of threats, and he as good as told Deeley to go ahead, and take the case up in the Law Courts, or anywhere else he liked! But nothing came of this particular dispute, though in the following year Swindon were very amused, so the story goes, to see the 'scissors' gear used on the '999' class 4—4—0s.

If Deeley, in turn, had copied exactly the setting used by Churchward on the *North Star*, and used long-lap valves and long travel, the '999' class would probably have shown such a superiority over the compounds in coal consumption and general performance as to end there and then all compound

Engine No. 1043: one of the last compounds to remain non-superheated, here seen in early L.M.S.R. days, at Kentish Town

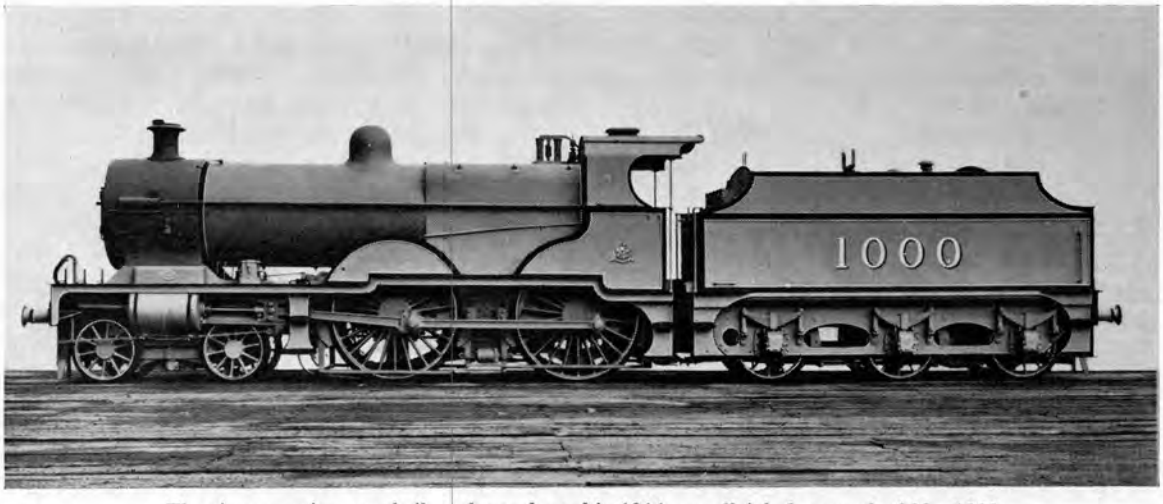
building on the Midland Railway. But despite the potentialities of the scissors gear the '999' class had a conventional valve gear design, and in the event they competed with the compounds on level terms. But it was one of the closest 'near misses' of locomotive history.

How comparisons between the two classes went in Deeley's own time we do not know, but perhaps the fact that another ten compounds were built at Derby in 1908-9 suggests that the compounds had the best of it. But Deeley was far from happy in other respects. I suppose the root causes of the friction that developed between him and the top management of the Midland Railway was one of personality. Like many another brilliant inventor he could be very 'touchy'. He was not allowed the autonomy enjoyed by his predecessor, nor yet that of many of his contemporaries on other leading railways, and in fighting to try and get it he gradually worked himself into a position from which there was no retreat save resignation.

Some rather highly-coloured stories of his going have been passed on; but I prefer to regard these as stories rather than fact. By his going, in 1909, the Midland lost a very able engineer; but in the twentieth century, particularly with a man like Guy Granet at the head of affairs, no individual, however brilliant, is going to have a smooth passage unless he can settle in as one of a team. This, Deeley seemed unable to do. He was succeeded by Henry Fowler, a man with a first-class brain, but with a placid disposition, and an almost self-effacing temperament; and so beneath the iron hand at the top, and the unchanging needs of the traffic department Midland locomotive practice, from 1909 onwards, descended into the doldrums, and stayed there until 1923.

This is not to say a good deal of careful scientific work was not done at Derby. Fowler was indefatigable, and as—unlike Deeley—he enjoyed the company of his fellow-engineers he took frequent part in the discussions of the Institutions of Civil and Mechanical Engineers, and read papers himself. To most outside observers Derby was virtually at a standstill from 1910 onwards. The rebuilding of Johnson 4—4—0s, even though into such a useful small-power unit as the 'Class 2' Superheater engines from 1913 onwards, could scarcely be regarded as progress. But from some of Fowler's contributions to the technical discussions of the day one can piece together more of what was happening inside Derby. The point that stands out today is that no significant use was made of the results until 1923. The development that made possible the astonishing revolution in L.M.S. motive power in the 1920s was complete in its entirety in 1913, with the rebuilding of the Deeley compound engine No. 1040.

The first occasion on which Fowler began to lift the veil on the comparisons between the compounds

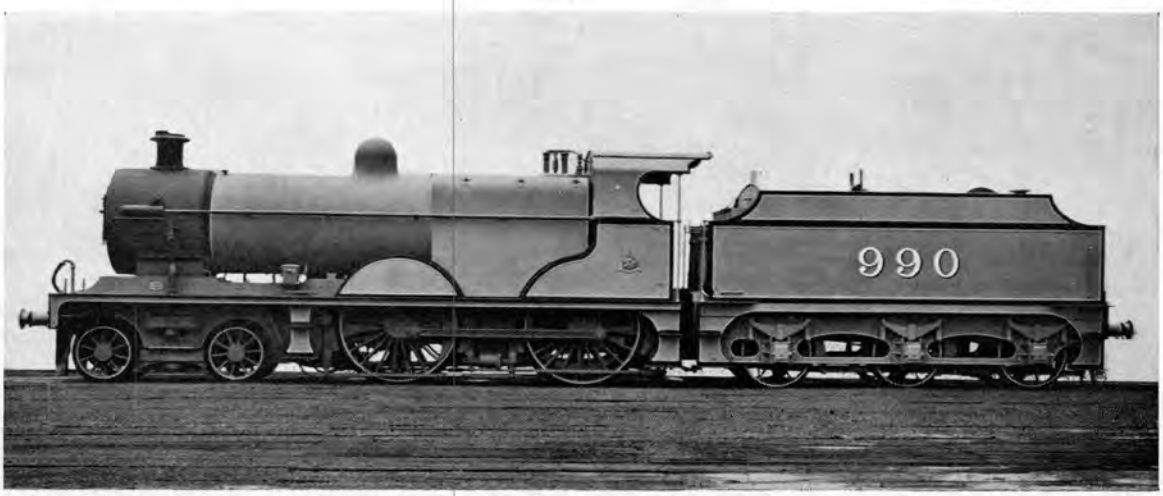


The pioneer engine, as rebuilt and superheated in 1914: an official photograph of No. 1000

and the '999' class came in April 1910 in a discussion at the Institution of Mechanical Engineers, on a paper by George Hughes of the Lancashire & Yorkshire Railway: *Compounding and Superheating in Horwich Locomotives*. He then revealed that the Midland Railway was about to try a superheater engine, but their position was rather different from that of the London & North Western Railway, because they would have an opportunity of trying it against a satisfactory compound engine. He went on to say, according to the report of the meeting:

'He thought that the author had put on one side in rather too summary a manner the question of compound engines for express passenger working, because no one travelling on the Continent could fail to realise that either the majority of the locomotive engineers there had been radically wrong or else there was something more to be said with regard to this type of engine. On the Midland Railway there were forty-five compound engines running, forty of which were working with a boiler pressure of 220 lb. and doing undoubtedly the most satisfactory as well as the most economical work of any express passenger engine on that line. Speaking generally, the repairs to the compound engine were not heavier than the repairs to the simple express engines: in the first compounds built trouble was experienced with the high-pressure boilers, but this had now been satisfactorily overcome.'

Tests of coal consumption had been made, all



The two-cylinder simple rival, No. 990, as rebuilt and superheated

with saturated steam engines, between a compound, a Johnson 'Belpaire', and a '999' between London and Leeds which gave the following results in coal per train ton mile:

Compound	0.112 lb.
'Belpaire' 4—4—0	0.120 lb.
'999' 4—4—0	0.115 lb.

To the figures Fowler added this remark: 'These tests, however, could hardly be taken as representing the everyday consumption, as with an inspector on the footplate the enginemen naturally did better than under ordinary working conditions, but the figures could be depended upon as being absolutely comparable.'

What was not comparable, however, was the boiler pressure on the compound and the '999' used in these tests. Whereas the latter engines originally had 220 lb. per sq. in., as on the compounds, by the time of these tests the '999' concerned was running with a reduced pressure of 200 lb. per sq. in., so that its nominal tractive power was considerably reduced. Even so the difference in coal consumption between the 'simple' and 'compound', at 0.115 to 0.112 lb. per train ton mile, was so slight as to make any conclusions valueless. Fowler then told the Institution of Mechanical Engineers that it was one of the '999' class that was being fitted with a superheater for experimental purposes.

Four years later Fowler read a paper himself before the Institution of Civil Engineers, in which he gave the results of several coal consumption tests, three of which affected the development of the compounds, thus:

Year	Engines Tested	Route
1910	998 (superheated) 1043 (saturated)	London — Leeds 3 return trips
1911	992 (saturated) 998 (superheated)	London — Leeds 6 return trips
1913	1039 (saturated) 1040 (superheated)	London — Leeds 5 return trips

The results of these trials clearly indicate the pattern of development. First of all, No. 998 proved vastly better than No. 1043, with an average coal consumption of 0.080 lb. per ton mile against 0.094 lb. Equally, No. 998 proved her superiority over the non-superheated No. 992. Then having established these results, and taken a decision to fit all the '999' class with superheaters, the next step was to try superheating on one of the compounds. It would seem that there was considerable reluctance at Derby to take this step. Authority had actually been received to rebuild the five Johnson compounds with superheater boilers in 1910-11, but the work was not immediately proceeded with, and it was not until the end of 1913 that No. 1040 was altered. In his paper to the Institution of Civil Engineers, Fowler said:

'The Midland Railway Company have a number of three-cylinder compounds, and a short time ago it was decided to superheat the steam supplied to the high-pressure cylinder of one of these. Although superheating in compound locomotives is practised on the Continent, some doubt was felt as to the effect of the continued high temperature in the high-pressure cylinder. So far (after three months' running) no disadvantages have revealed

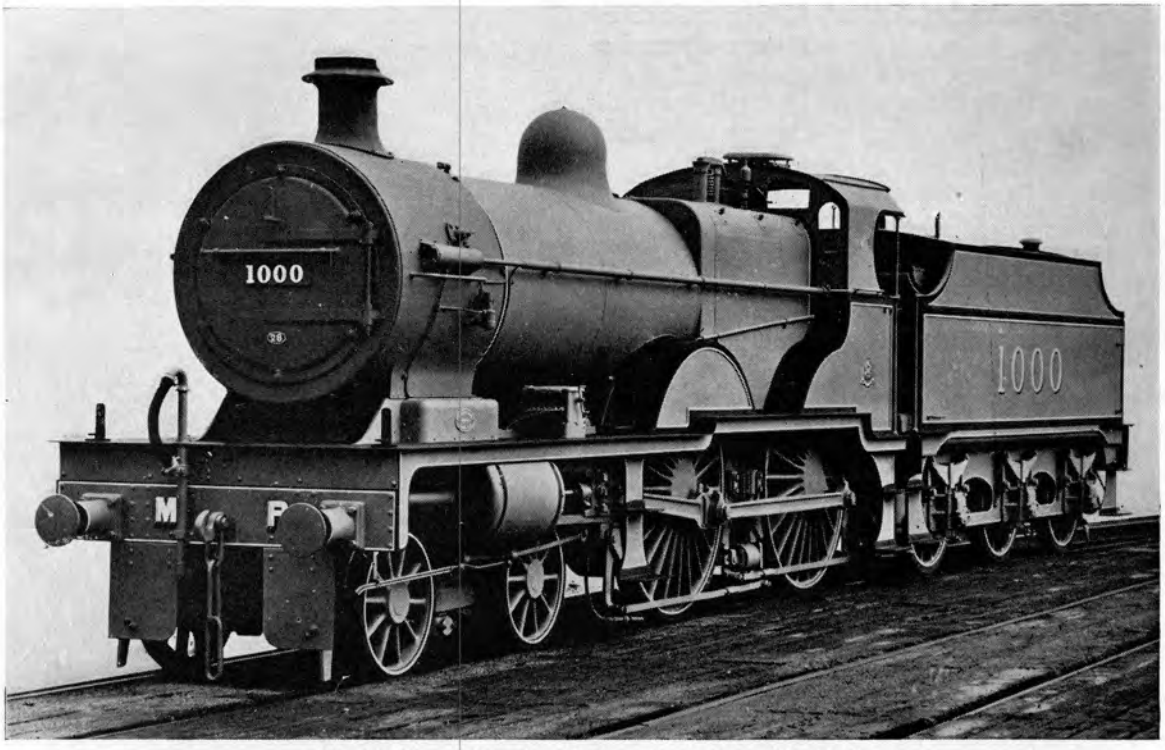
One of the original Johnson engines, as rebuilt and superheated, No. 1003, originally No. 2634

themselves, and the engine has run perfectly satisfactorily. Coal consumption tests of engine No. 1040, using superheated steam, and of a sister engine, No. 1039, using saturated steam, have been made, and the results are given in Table IV.* The tests show a saving of 25.9 per cent. in coal and 22.3 per cent. in water over the consumption with the locomotive using saturated steam. It will be seen that the coal consumption for the superheater compound locomotive is exceptionally low.'

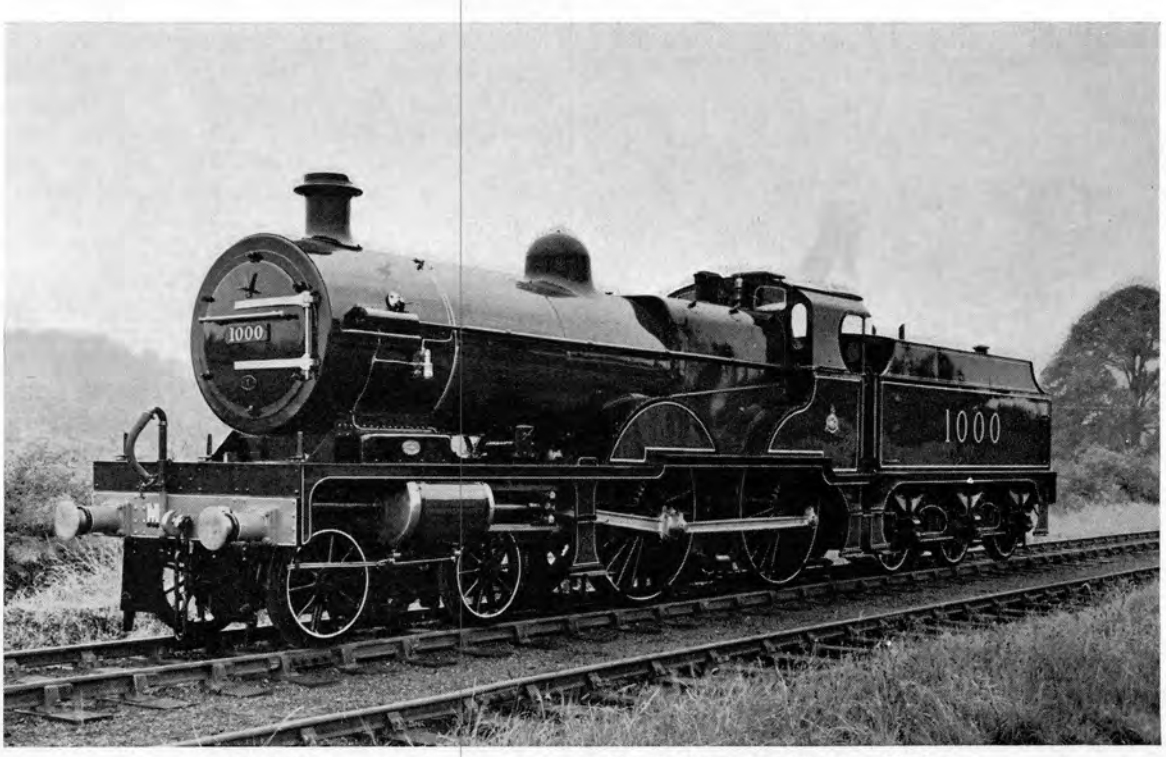
It certainly was. Against the figures previously quoted those of engine No. 1040 averaged no more than 0.068 lb. per ton mile.

The astonishing thing is that no practical advantage was taken of the greatly improved capacity of the engine *in load haulage*. Whether this was

* Of Fowler's paper



No. 1000, as originally rebuilt and superheated in 1914



No. 1000, as restored, and now preserved in the Transport Museum, Clapham

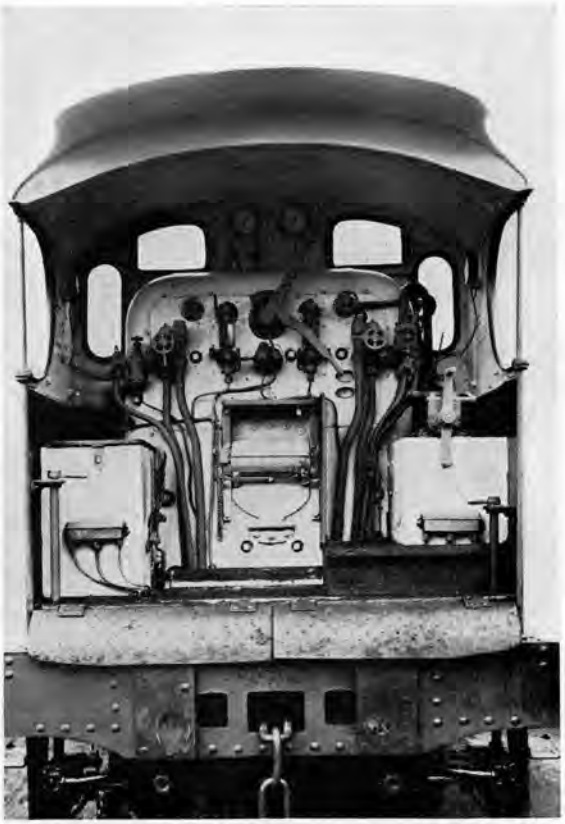
officially measured and recorded in a specific series of tests I cannot say, but there was one occasion when light burst through the 'iron curtain' of the General Superintendent's loading regulations, and No. 1040 had to take a train of 315 tons on 'Special Limit' timings. Fortunately there was a pair of great sportsmen on the footplate who were prepared to really go for it, and still more fortunately there was a very experienced recorder and locomotive enthusiast on the train in the person of Mr. E. L. Ahrons, the well-known engineering historian. This particular train, the 11.20 a.m. from Leeds, was allowed 86 min. for the 72 miles from Kettering to St. Pancras, but this time included provision for a conditional stop, to set down, at Cricklewood. Furthermore, the train was running a quarter of an hour late so there was every incentive to make a good run. Nevertheless the tare load of 296 tons was 56 tons over the limit for a Class 4 engine, and one wonders by what lapse in the Control organisation the train was allowed to start at all, without a pilot! Anyway, the accompanying log shows what happened.

KETTERING—ST. PANCRAS

Load: 296 tons tare, 315 tons full
Engine: Superheater 3-cyl. compound No. 1040

Dist. miles		Actual m. s.	Speeds m.p.h.
0.0	KETTERING	0 00	—
7.0	Wellingborough	9 00	62
12.4	*Milepost* 59¾	14 56	43
—	Sharnbrook	—	78½
22.2	BEDFORD	23 49	—
30.2	Ampthill	31 52	49½
38.0	*Milepost* 34	41 34	43
41.8	LUTON	45 47	—
52.1	St. Albans	55 22	—
—	Radlett	—	77
59.6	Elstree	61 53	—
65.1	Hendon	66 51	—
66.9	CRICKLEWOOD	69 05	Conditional stop

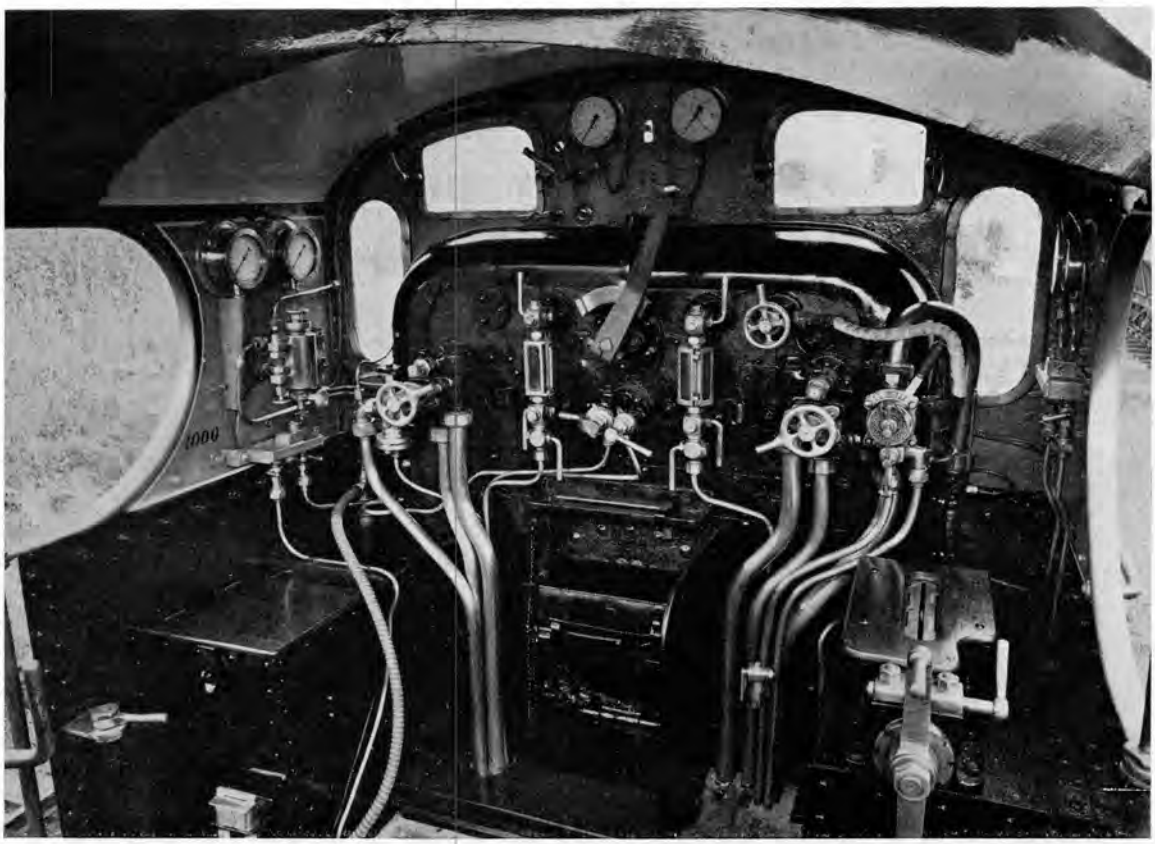
One might have thought from the times and speeds achieved that this was one of the normal pre-war trains of 200 to 215 tons, such were the uphill speeds. There was no shutting off steam either on the down gradients, and Ahrons recorded that the 10 miles between mileposts 58 and 48 took only 8 min. 17 sec. Such work became commonplace in L.M.S. days, but in 1914-6 it was a phenomenon on the Midland Railway. Some of the finest running ever performed by the non-superheated Deeley compounds took place in the early years of World War I, before the drastic decelerations of 1917, and one could sometimes see loads



The cab of a standard Midland compound No. 1043

slightly in excess of the 240-ton limit taken without pilot assistance. I have before me details of five runs down from St. Pancras, on which the tare loads were, successively, 245, 246, 251, 244, and 261 tons. The last-mentioned train was actually worked by a superheater engine, No. 1001, which had been rebuilt on similar lines to No. 1040 in January 1915. At this stage I should mention that when No. 1040 was superheated the original 220 lb. pressure was retained, and this pressure was retained in four of the Johnson engines, 1000, 1001, 1003 and 1004, which were rebuilt in 1914-15. But the war seemed to bring the process of fitting superheaters to the compounds to a standstill, and nothing more was done in this respect till 1919.

Of the war years, Cecil J. Allen wrote in August 1918: 'I have recently received a plaint from an old friend, whom I well know to be an ardent Midland enthusiast, to the effect that the locomotive work of that company has received scant attention in these columns for some time. On looking back over past numbers I must admit the impeachment, as the last series of Midland runs appeared in March 1917, but, truth to tell, the super-drastic treatment of the Midland time-tables from the beginning of 1917



The cab of No. 1000, as restored for preservation, showing the pyrometer gauges on the left hand side, and later discarded in service

and subsequently has stripped every vestige of interest from the locomotive performance of that line. Maximum speed restrictions, which I now find to be as severe as 40 m.p.h. throughout between Trent and Manchester, and 45 m.p.h. to 50 m.p.h. elsewhere over almost the whole of the Midland main lines, coupled with the most sluggish of uphill work, leave nothing worthy of record, and as I have been endeavouring as far as possible to combine a certain amount of current locomotive work with the description of logs taken before the high tide of deceleration set in, it is not, perhaps, remarkable if I have somewhat neglected the Midland Railway. Especially is this the case in that very little excess over pre-war loads on Midland expresses still suffices to call forth a pilot locomotive, so that one is not able to test the capacity of Midland engines even under war loading conditions—a pastime which still affords a considerable amount of interest on other lines, despite drastic decelerations.'

It is easy to be critical, without knowing all the facts of what went on behind the scenes, but having produced an engine of the calibre of No. 1040 one would have thought that a strong recommendation would have gone from the Chief Mechanical Engineer that the whole stud of 45 compounds be converted forthwith to enable heavier loads to be hauled, and reduce the amount of piloting necessary. They could have been classed '4X' or by some other distinction from the ordinary Class 4 engines, and given a much higher load rating, and the savings in coal and wages would have paid for the conversions over and over again. But then, of course, under the prevailing organisation the Chief Mechanical Engineer was not responsible for running, and unless the General Superintendent asked him to accept a higher load limit there was, I suppose, no point in suggesting that certain engines might be worked harder. It would increase the maintenance charges on those engines, and that the Chief Mechanical Engineer would wish to avoid.

But from whatever causes it may have been, no advantage whatever was taken by the splendidly modernised compounds on the line from 1913-15 onwards. During the war, indeed, to reduce maintenance no doubt, the boiler pressures on the five

superheater compounds, which were originally 220 lb. per sq. in., were reduced in 1916 to 190 lb. per sq. in. on Nos. 1000, 1001, 1003, and 1040, though No. 1004 carried a pressure of 220 lb. per sq. in. until January 1918, when she too was reduced to 190.

It is evident from details of many runs that the superheated '999' class engines had a considerable advantage over the standard Deeley compounds, and in view of the subsequent success of the superheated compounds it is interesting to speculate upon the reasons for preferring, in the first place, the '999' class to the compounds in the matter of superheating equipment. The Deeley compounds nearly all working south of Leeds were generally master of the tasks set to them. In all probability the money available for superheating was limited, and in such case Fowler felt no doubt that the motive power stud as a whole would be benefited most by the equipment of all the '999' class, rather than doing a few of the compounds. But from whatever case the situation arose, taken all round the '999' class had supplemented the compounds as the premier engines of the Midland Railway—for a time, at any rate. Following the conversion of No. 1040, the four other compounds that were fitted with superheaters during the war period became available as follows:

No.	Date converted with 220lb. boiler	Date of B.P. reduction to 190 lb.
1000	November 1914	June 1916
1004	November 1914	January 1918
1001	January 1915	July 1916
1003	May 1915	November 1916

After the war work began on the superheating of the Deeley compounds, albeit very slowly. No. 1002 of the original Johnson series, the conversion of which had been authorised in 1910 (!), was done at once, in January 1919; but only two other engines were converted in that year, Nos. 1008 and 1014. The year 1920 saw only two more converted, namely, Nos. 1039 and 1042, and in the following year the total of conversions was still only three—engines 1012, 1015 and 1037. Thus at the end of 1921 the Midland Railway still had no more than 13 superheated compounds. But there was no change in traffic policy after the war, and the attentions of Derby were mostly concentrated on rebuilding 4—4—0 simple engines to provide as many as possible of the 7ft. superheated type ('483' class), and to superheat the Johnson 'Belpaires', which constituted No. 3 class in the passenger stud. The aim was clearly to provide as large a fleet as possible of moderate-powered, superheated engines, rather than make the most of the compounds, which when superheated stood in a different sphere altogether from the 'Class 2' and 'Class 3' superheater engines. To outside observers, indeed, it seemed as though the Midland Railway still regarded superheating as an *alternative* to compounding, rather than as an ally.

It is true that in the last year of the old Company eleven more compounds were superheated, namely, 1006, 1007, 1009, 1011, 1016, 1020, 1023, 1024, 1031, 1035 and 1038; but nevertheless no fewer than 21 of them passed into L.M.S.R. ownership with saturated boilers. It was an extraordinary position for a company which in every other sense was unquestionably the strongest and most influential constituent of the entire group. For express passenger traffic it possessed only the 10 simple 4—4—0s of the '999' class, and the 24 superheater compounds that could be considered as first-line motive power in the year of grace 1923. Such were the

Glasgow—St. Pancras express leaving Carlisle hauled by superheated "999" class engine No. 998

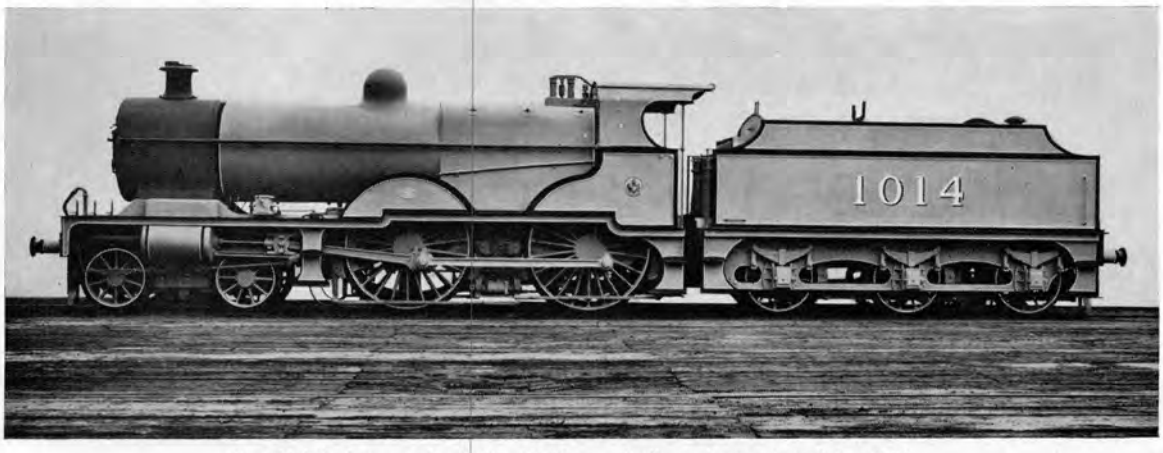
In L.M.S.R. days: one of the original Johnson compounds No. 1005, passing Belper with an up Manchester express

Engine No. 1007, in later L.M.S R. days, with hybrid tender, having long wheelbase and short tank

results of the Midland traffic organisation in company with a complacent locomotive administration at Derby.

It is true that for much of the war Fowler was away, rendering invaluable national service at the Ministry of Munitions—from which he returned with a knighthood and a K.B.E. But the pattern of events at Derby did not change on his return. In 1922 who would have dared to suggest that Derby, the home of nice little 4—4—0s, watched over, according to one of its more facetious sons, by a 'Society for the Prevention of Cruelty to Engines', would, within six years, be dominating the entire motive power position on the L.M.S.R.—from Shoeburyness, Bournemouth and Bristol to Wick and Thurso!

At the time of grouping, however, all was not well with the superheater compounds. The reduc-



An official photograph of No. 1014, as rebuilt and superheated in 1924

tion in boiler pressure to 190 lb. per sq. in. was unaccompanied by any change in cylinder dimensions, with the result that the nominal tractive effort of the locomotives was reduced, and cases of lost time over the heavy road between Derby and Manchester became so frequent *with the superheater compounds* that a full-scale investigation was begun. In certain instances the locomotives were reported as not steaming freely. Over Peak Forest summit the principal London—Manchester expresses were operating to 'limited load' timings that permitted a maximum of 260 tons tare to an unpiloted engine of No. 4 class. Engine No. 1011, which had been rebuilt and superheated in 1922, was chosen for the purpose of these trials, and they began in February 1923. The experimental modifications to engine No. 1011 included changes to the valve gear and the fitting of a 'booster'.

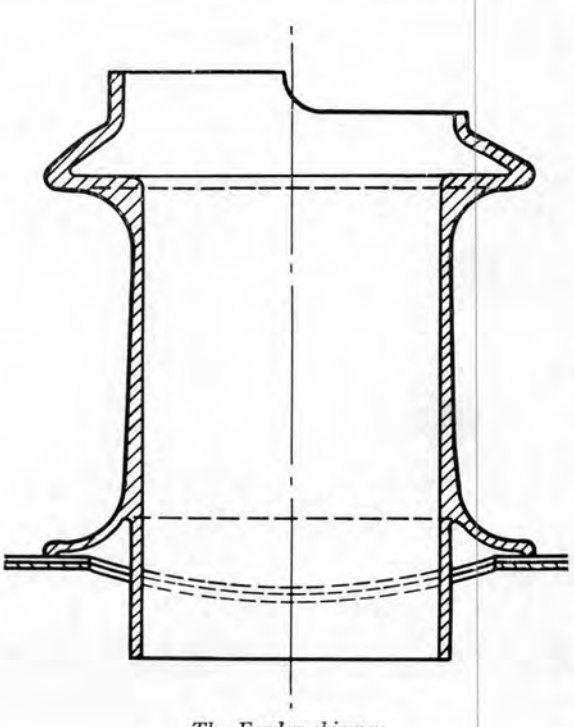
I am very much indebted to Mr. R. C. Bond, now Technical Adviser to the British Railways Board, for comprehensive details of these tests. As a pupil of Sir Henry Fowler he assisted throughout the series, taking indicator diagrams off the engine, and he has put all his personal notes at my disposal. The engine was fitted with a booster pipe admitting live steam from the superheater header direct to the low-pressure steam chest. This booster pipe was under the control of the driver by means of a plain stop-valve. This amounted to the revival, in a much simplified form, of one of the old Smith-Johnson controls, except that the opening to steam could not be varied during a run. It was adjusted before the start, and the driver could either open the pipe, or close it. Three different arrangements of the high-pressure cylinder valve gear were tried, though the 'booster' was used only with the original valve gear, which had 1 1/16 in. lap. The two alternative arrangements had $\frac{7}{8}$ in. and 11/16 in. lap respectively. The low-pressure gear remained unchanged.

Bond has told me that the object of altering the high-pressure valve gear was, by reducing the lap of the high-pressure piston valve, to increase the total power of the engine, and to effect a more even distribution of the work among the three cylinders. As a basis of comparison with the different arrangements of engine No. 1011 similar tests were conducted with a standard saturated compound, No. 1017, and a superheated '999' class simple 4—4—0

Down Manchester express passing Millers Dale Junction in the heart of the Peak District. Engine No. 1028, and train of L.M.S.R. stock

Sir Henry Fowler, K.B.E., chief mechanical engineer Midland Railway 1909 to 1922: chief mechanical engineer L.M.S.R. 1925 to 1931

Up Manchester express near Duffield hauled by No. 1012



The Fowler chimney

No. 997. Advantage was taken of the changed situation since grouping to attach the former L. & Y. dynamometer car to the train on certain of the tests. This was the first time any Midland engines had been tested with a dynamometer car. This was done as early as April 1923.

The three valve gears tested on engine No. 1011 had the following dimensions:

	A (standard)	B	C
Outside lap	$1\frac{1}{16}$ in.	$\frac{11}{16}$ in.	$\frac{7}{8}$ in.
Exhaust clearance	$\frac{3}{16}$ in.	$\frac{3}{16}$ in.	$\frac{1}{8}$ in.
Cut-off %			
Notch 3	30	44	36
,, 6	52	67	59
,, 9	67	80	73
,, 12	77	87	82

The low-pressure cut-offs, in notches 3, 6, 9 and 12 respectively, were 32, 55, 72 and 81. Before the trials all compounds had arrangement A. Some results from engine No. 1011, showing the maximum horsepower developed in different conditions are most interesting.

MAXIMUM HORSEPOWER

Condition of engine	Speed m.p.h.	Notch	Total I.H.P.	Distribution of Work	
				% H.P. cyl.	% both L.P. cyls.
Gear A Booster shut	60	6	933	58.4	41.6
Gear A Booster ½ open	58	6½	979	49.7	50 3
Gear A Booster full open	53	5½	724	35	65
Gear B	42.2	7	1018	46.9	53 1
Gear C	60	6	1012	55 2	44 8

Taken by themselves, these results do not mean a great deal, but some closely comparable results at similar speeds reveal the difference in performance with the three different valve gear arrangements much more clearly. All the figures relating to 'A' gear are with the booster shut.

Valve Gear	Nominal Speed m.p.h.	Actual Speed m.p.h.	Notch	Total I.H.P.	Distribution of Work	
					% H.P.	% both L.P.
A	20	20	8.5	618	50.8	49.2
B		19	10	683	44.5	55.5
C		19.4	9	703	44.8	55.2
A	30	30	9	830	52.4	47.6
B		31.9	8	944	45.9	54.1
C		30.6	9	811	49.3	50.7
A	35	35	6	691	55.7	44.3
B		36.6	6	883	46.9	53.1
C		34.8	6	878	50.8	49.2
A	40	39	6	714	56.6	43.4
B		40.5	6½	961	47.8	52.2
C		40.1	7	966	51.2	48.8
A	45	46	6	787	58.1	41.9
B		43.3	6	969	46 9	53.1
C		45	6	900	53 9	46.1
A	50	50	6	834	57 6	42 4
B		52.9	5	844	49 5	50.5
C		49.4	6	925	54.4	45.6
A	60	60	5	784	58.4	41.6
B		60	5	796	46.0	54.0
C		55.9	5	824	54.0	46.0

The above results show that in comparable conditions of running the 'B' arrangement of the valve gear gave the best all-round performance particularly in the range of speed from 30 to 50 m.p.h., between which the hardest work would be required from the engines in climbing the long and sustained adverse gradients to Peak Forest and to Aisgill. This gear also gave the best coal consumption figures. The average of *all* values under the various conditions were:

Condition of engine	lb. of coal per ton mile
Valve gear A booster shut	0.1142
,, A booster ½ open	0.1187
,, A booster full open outward trip ½ open return	0.1275
,, B	0.1033
,, C	0.1075

On certain runs with the 12.20 p.m. express from Manchester to Derby the engine No. 1011 had indicator diagrams taken and a full dynamometer car record was made. It is interesting to compare the coal consumption of the engine No. 1011 with her original valve gear, but with the booster half open, with those of the non-superheater compound, and with the '999' class simple, as follows:

Engine No.	Load tons tare	Coal per mile lb.	Average D.B. Pull Cheadle Heath to Peak Forest Tons
1011	258	39 1	3.712
,,	259	49.5	3.356
1017	258	56.5	3.675
,,	255	57.1	3.686
997	258	50.9	3.776
,,	254	54.1	3.882

Why the coal consumption of engine No. 1011 showed such variation on her two days is not explained; but the high figures for the saturated steam compound are very noticeable.

As a result of these trials the standard valve setting for the superheater compounds was changed to the 'B' arrangement, namely, 11/16 in. outside lap and 3/16 in. exhaust clearance. The cut-offs corresponding to the various notch positions were standardised thus:

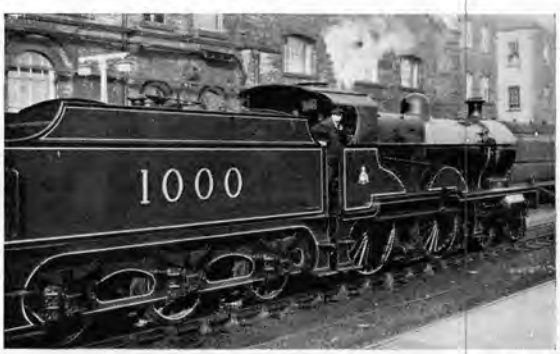
Notch	H.P. cyl. %	L.P. cyl. %
3 . . .	44	32
6 . . .	67	55
9 . . .	80	72
12 (full gear) . .	87	81

It was with this setting that the compounds entered upon their career under L.M.S. ownership.

The Deeley compounds, as superheated, had the following boiler dimensions:

Tubes: 148, 1¾ in. outside dia.
21, 5⅛ in. outside dia.

Heating surface:	
Tubes	1170 sq. ft.
Firebox	151 sq. ft.
Superheater	360 sq. ft.
Total	1681 sq. ft.



An interesting photograph of No. 1000, taken at Derby in 1959 after restoration

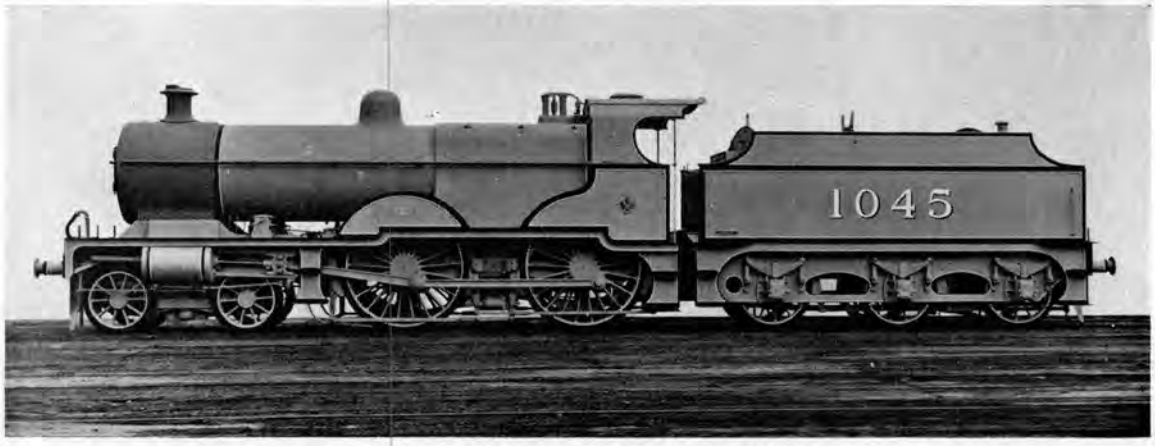
A standard Midland superheater compound, No. 1013, in L.M.S.R. days

CHAPTER 5

L.M.S.R. AND THE FIRST LEEDS-CARLISLE TRIALS

The formation of the London, Midland & Scottish Railway, on January 1st, 1923, did not see the Midland itself in a particularly strong position so far as first-line motive power was concerned. The London & North Western entered the L.M.S. group with 130 'Claughtons', no fewer than 245 'Prince of Wales' class 4—6—0s, and upwards of 140 superheater 4—4—0s of the 'George the Fifth' and superheated 'Precursor' types—all of which latter were in haulage capacity and speed the equal of anything running on the Midland at that time. The Lancashire & Yorkshire had just carried out a successful rebuild of the Hughes 'Class 8' 4-cylinder 4—6—0, but had otherwise little contribution to make, while in Scotland the Caledonian was still building the massive and generally useful Pickersgill 4—4—0 design of express passenger locomotive. Neither the Glasgow & South Western nor the Highland Railways had any contribution to make towards the new standard motive power stud of the group. In sheer weight of numbers alone the odds were on the London & North Western.

In January 1923 the Midland had no more than 34 locomotives that could hold a candle to the massive array of 515 Crewe-designed express passenger engines, all capable of tremendous feats of haulage on the road. It is true that after grouping the 'George the Fifths' and 'Superheated Precursors' were placed in No. 3 class along with the Midland 'Belpaires'. But even the most ardent of Midland supporters would find such a classification hard to justify. By all ordinary standards a 'George' was the equivalent of a Midland compound in every respect, and no one outside Derby would then have suggested that a 'George' was not substantially the superior of a Midland '999' class 4—4—0. Standardisation was to be the watchword of the new grouped railway organisations. How then could 24 superheater compounds and 10 'Class 4' Midland simples prevail against 515 L.N.W.R. superheated express locomotives! History has recorded, however, that many factors other than technological, or even economic, considerations prevailed in the early days of the L.M.S. group, and the result was a



An official photograph of No. 1045, the first of the 6ft. 9in. compounds

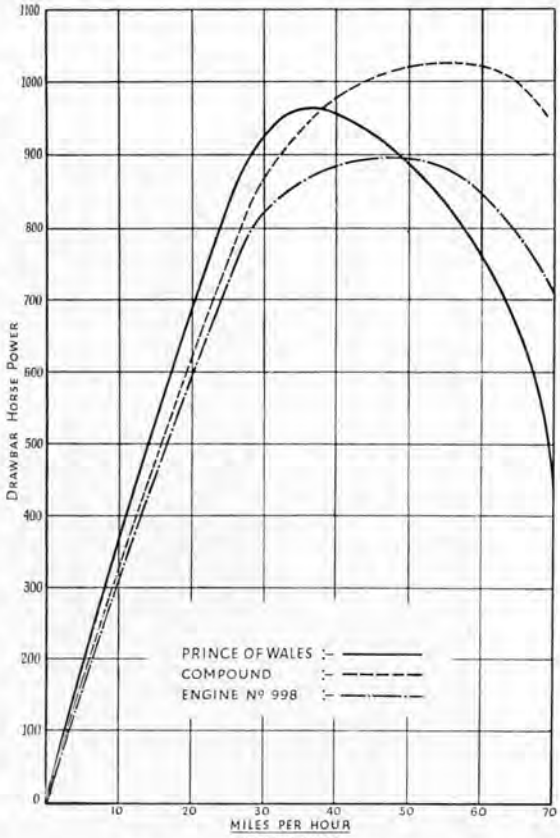
One of the long-chimneyed 6ft. 9in. engines, No. 1061, attached to tender numbered 1050

fascinating period of locomotive history over which the shades of Samuel Waite Johnson and Walter Mackersie Smith must surely have chuckled with delight.

Whatever the solid achievement of Crewe works may have been in provision of motive power for the old L.N.W.R., the period of amalgamation caught the Company in a very weak moment, both in respect of management and in senior engineering direction. H. P. M. Beames, the Chief Mechanical Engineer, had been appointed to the office as recently as 1920, and when the merger with the Lancashire & Yorkshire Railway took place in 1921 he had to give way to George Hughes, who was many years his senior. And in 1923 Sir Henry Fowler, of the Midland, became the Deputy Chief Mechanical Engineer of the L.M.S.R. In a far more important respect than that of engineering personalities, however, Midland precepts and practices became the predominating influence in the entire group. Sir Guy Granet, formerly General Manager of the Midland, and in 1923 one of its most prominent and influential directors, was by far the strongest personality in the whole of the new organisation, and he virtually dictated the terms of amalgamation and the form the administration of the L.M.S.R. should take. Through his influence a Midland man, John Follows, was appointed to the key position of General Superintendent. This made it certain that the Midland system of traffic organisation, rather than the North Western, would be adopted generally, and in that organisation the responsibility for locomotive running rested with the General Superintendent rather than the C.M.E.

As related earlier in this book, the whole policy of Midland operating, since 1907, had been to run a frequent service of light trains, with relatively small engines. Nothing could have been further from this than North Western practice prior to grouping; but after 1923 a sustained attempt was made for some years to reduce train weights on the West Coast Route in preparation for a remodelling of the timetable on Midland lines. The policy of the operating department had its effect on the early locomotive policy of the L.M.S.R. in tending to concentrate attention on the medium-powered rather than the top-line express locomotives.

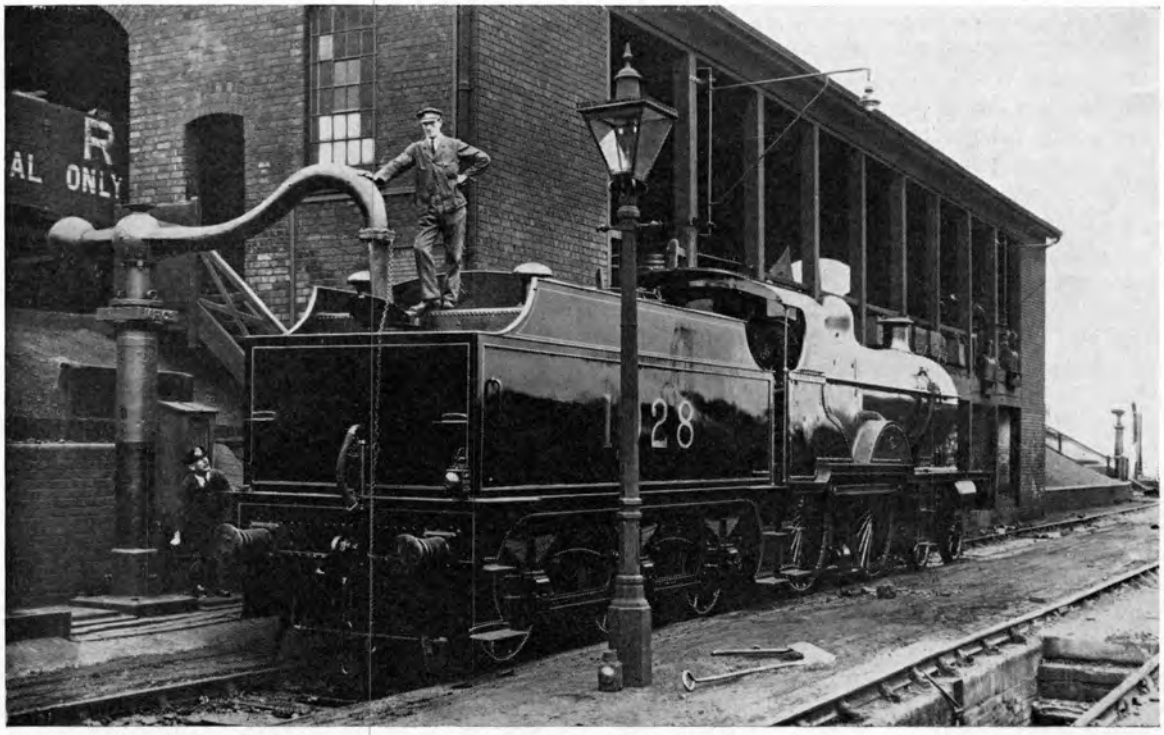
It is true that after the merger of the Lancashire & Yorkshire Railway with the L.N.W.R. some comparative trials with 4—6—0 locomotives had been carried out between Crewe and Carlisle; but after grouping it was the Class 4 engines that came into the picture, and at the end of the year 1923 a series of trials was commenced between Leeds and Carlisle between a Midland compound and a '999' class 4—4—0 on the one hand, and a North Western 'Prince of Wales' 4—6—0 on the other. Although many tests had been conducted on the Midland Railway in earlier years, in which the engines had been indicated, this was only the second occasion on which full-dress trials with a dynamometer car had run. The car used was that of the former Lancashire & Yorkshire Railway.



350 TON LOAD

DRAWBAR HORSEPOWER AND SPEED CURVES
CARLISLE-LEEDS DYNOMETER CAR TESTS.

Engine No. 1028, superheated, in early L.M.S. days



No. 1028 alongside coaling stage

The object of the tests, as stated laconically in the official report, was 'to ascertain the comparative coal, water and oil consumption and engine performance of the three under-mentioned engines'; the report then stated the numbers of the individual engines concerned. The trains chosen were the 12.10 p.m. up from Carlisle, making a non-stop run of 113 miles to Leeds in 143 min., and the 4.7 p.m. from Leeds, also non-stop, on a slightly faster schedule of 135 min. to Carlisle. The booked average speeds were 47.5 and 50.3 m.p.h. start to stop. In the Midland loading classification these trains both came in the 'limited load' category, on which the maximum unpiloted tonnage for a Class 4 superheater engine was 260 tons. Although the overall times were not unduly fast the point-to-point bookings over the uphill stretches of the 'mountain' section between Settle Junction and Carlisle were quite sharp, in relation to the size of the engine concerned. Moreover the test conditions laid down were 'that each engine should take the 300 and 350-ton train loading without assistance, and every effort be made to conform to the working times allowed throughout the run, particularly between Carlisle and Blea Moor Signal Box on the outward trip, between Leeds and Aisgill Signal Box on the return trip.'

How the Midland authorities were persuaded to load their carefully nursed and 'petted' engines to such a figure as 350 tons over Aisgill is certainly one of the mysteries of locomotive history; but on the other side one can well imagine the men of the North Western arguing that 300 tons was not worth pulling! For the test period the three competing engines were based at Durran Hill shed though they did not use the coal normally supplied to Midland express locomotives working from that depot, which was Tyneside. Instead the test engines were fired with one of the very best South Yorkshire 'hards' Grimesthorpe, which was a grade normally used by engines working from Leeds Holbeck shed. Grimesthorpe would have been an unfamiliar coal to the North Western driver of the 'Prince of Wales' class 4—6—0 No. 388. This driver and engine had been regularly working between Carlisle and Leeds for sometime prior to the tests. The driver was quite familiar with the road, but not with Grimesthorpe coal, and so for a week prior to the tests engine No. 388 was supplied with Grimesthorpe 'hards' for its ordinary work. The driver thus entered upon the test period familiar with the road, and needing no pilotman, and reasonably familiar with the coal.

The trials began on December 10, 1923, and lasted until January 17. It can be said, without any exaggeration, that never before had there been such running on the Midland Railway. The enginemen entered into the spirit of it with tremendous gusto; partisanship for the Midland on the one hand, and for the North Western on the other, rose to fever heat, so that quite apart from the scientific aspects of the tests some magnificent individual feats were achieved with each of the competing locomotives. The bare details of performance are given in the tables I and II.

TABLE I
CARLISLE—LEEDS
PASSING TIMES

Miles from Carlisle Station etc.		Lazonby	Aisgill	Blea Moor	Leeds
Schedule	min.	21	68	80	143
Engine No.	Load tons	Actual m. s.	Actual m. s.	Actual m. s.	Actual m. s.
388	305½	24 24	68 46	81 12	141 51
	302½	23 13	68 53	81 24	142 14
	305½	23 37	66 58	79 36	143 28
1008	305½	23 18	63 01	75 18	140 23
	209½	23 16	66 09	79 09	141 07
998	309½	23 05	64 28	76 30	140 47
	293½	24 11	67 18	78 46	140 10
	303½	24 05	69 29	81 54	139 18
	302½	24 15	70 33	83 00	142 08
	304½	23 48	68 08	80 16	136 56
	313½	23 23	68 56	80 55	144 25
388	352½	23 20	66 09	78 17	143 06
	354½	25 08	72 34	85 15	143 41
1008	354½	22 51	64 31	76 54	139 40
	355½	23 46	65 39	78 59	142 18
	349½	23 16	67 32	79 36	137 40
	352½	24 22	67 19	79 54	143 04
998	356½	25 07	83 59	96 28	150 54
	353½	23 57	71 59	85 03	150 01

The first table gives the passing times at Lazonby, Aisgill and Blea Moor, together with the overall times from Carlisle to Leeds, and it will be seen that except on those runs when signal checks were experienced good time was kept from end to end, though there was some variation in the sectional timings. Nevertheless, the idea of a Midland compound consistently taking a tare load of 350 tons past Aisgill summit in less than 68 min. from the start at Carlisle was so revolutionary that prior to that winter of 1923-4 the most ardent of Midland supporters would have stoutly resisted any suggestion that such a thing was possible.

Here I am not really concerned as to how competitors fared, except in the comparison these trials made between the work of a '999' and a compound. The data in Table I suggests that the compound was the most consistent performer of the three, and her uphill work with the 350-ton trains was amazing by previous Midland standards. It must not be forgotten also that the trials were carried out in the depths of winter on a road particularly subject to the most severe weather conditions. Although there is no specific information on this point in the official report, one can draw the conclusion that the weather was tolerably good for most of the trial period. The equality of performance between the three engines in the heaviest working conditions is most clearly illustrated in Table II, in the climbing from Settle Junction to Blea Moor with 350-ton trains. Here all three engines lost time on the sharp allowance of 22 min., and the variation between one engine and another, and between trip and trip were a matter of seconds rather than minutes.

TABLE II
LEEDS—CARLISLE

		Settle Jc. Blea Moor	Blea Moor Aisgill	Min. speed on bank
Schedule min.		22	13	
Engine No.	Load tons tare	Actual m. s.	Actual m. s.	m.p.h.
388	290½	21 59	12 56	33.8
	300½	22 50	13 27	29.0
	294½	21 54	11 53	30.0
1008	293½	20 43	13 06	33.1
998	298½	21 53	13 17	29.0
	302½	24 59	13 21 }	not
	281½	21 21	12 56 }	quoted
	298½	24 02	15 26	26.8
	301½	22 02	13 45	27.7
	295½	21 28	13 13	30.5
388	345½	24 29	13 38	28.5
	342½	25 28	13 57	26.2
1008	343½	25 21	14 10	26.0
	342½	25 15	12 53	25.0
998	353½	24 56	14 48	22.0
	344½	25 45	16 12	19.5

All the same when minimum speeds on the bank are studied the '999' class engine made the poorest showing. It was common practice with these engines to run very hard on the initial stretch downhill from Hellifield to Settle Junction, and by passing the latter point at well over 70 m.p.h. to gain some useful impetus for the climb. On the two runs with the 350-ton trains it seems fairly clear that engine No. 998 was short of steam at Blea Moor, and the slow recovery to Aisgill on the last run of the series provides corroborative evidence. It is sometimes said that the capacity of a locomotive can be gauged from its grate area. On this basis, and on the exact similarity of their boilers, the compound and the '999' should have put up identical performances. But it does not require any

Engine No. 1022 on one of the centre roads at Carlisle

Down Manchester express near Cromford hauled by No.1048

Up Leeds express passing Elstree, hauled by No. 1039

examination of the dynamometer car records to appreciate that in the most severe conditions of working the compound had a very definite advantage over her rival. A practised observer, travelling as a passenger in those Scottish expresses and recording the times, mile by mile, could tell quite clearly when the '999's' effort began to flag.

All the same it was a hard task to set to any engine of Class 4 capacity. Fourteen miles of almost continuous 1 in 100 ascent: past the old-world town of Settle, beneath the limestone cliffs of Stainforth, and then through the dramatic gorge of the Ribble, crossing that brawling mountain stream on massive stone bridges, the piers of which are clearly designed to withstand a torrent of flood water. Then out into the bleak wastes of moorland, with the mountains of upper Ribblesdale and the vastness of the landscape making the trains look like the tiniest models when seen from any distance away. It was certainly a majestic arena in which to stage a trial of strength, just as the drag from Ormside viaduct up to Aisgill, on the northern side of the summit can be a 'killer' to the engines of southbound trains. In many ways, however, the northbound climb is more severe, for it is followed by the sharply-timed run of 11.2 miles on level and slightly rising gradients from Blea Moor to Aisgill; it was here that No. 998 on her last trip was limping to such an extent as to lose 3¼ min. in this relatively short distance.

The work of the compound, No. 1008, was consistently superb, and although the North Western 4—6—0 No. 388 slightly surpassed her efforts on some of the banks it proved, by the dynamometer car results, to be at the expense of a higher coal consumption. Of course, Midland locomotive men were always inclined to regard No. 1008 as a star engine at any time. An old friend of mine who was trained at Derby more than once referred to her as 'the flower of the flock'. Not only this, but as the official report states, she had just been worked into condition after a general repair at Derby. In other words, not only was she inherently a very good engine, but at the time of the trials she was in the very prime of condition. Both the North Western 4—6—0 and the '999' had been out of shops for six months, and although both were in good condition there could not have been that pristine freshness about them that helped No. 1008 to do so well. From Table I it will be seen that she made considerably the fastest times between Carlisle and Aisgill summit in both the 300-ton and the 350-ton series of tests.

These two runs, made on December 17 and 18, 1923, probably represent the finest all-round performances ever achieved with the true Midland compounds, considered apart from those of later variants of the design standardised by the L.M.S.R. It is perhaps significant of the absolute mastery over the job shown by No. 1008 and her crew that after no more than one round trip with a 300-ton train the test authorities gave the engine 355 tons on the very next day! The North Western 'Prince' had three days of 300-ton running before she was given 350. The logs of the runs made by No. 1008 in her first two southbound trips are detailed in Table III.

One of the first batch of 6ft. 9ins. engines, No. 1053, on up Manchester express passing Elstree

TABLE III

L.M.S.R. 12.01 p.m. CARLISLE—LEEDS
Engine: 4–4–0 Compound No. 1008

Date / Loads tons E/F			17/12/23 306/320		18/12/23 355/370	
Dist. Miles		Sch. min.	Actual m. s.	Speeds m.p.h.	Actual m. s.	Speeds m.p.h.
0.0	CARLISLE	0	0 00	—	0 00	—
2.7	Scotby		6 23	32¼	6 15	31
—			—	41½	—	42
8.4	*Low House*		15 42	34	15 40	37½
13.5	*Summit*		21 19	50	21 08	53
15.4	Lazonby	21	23 19	66	22 51	69½
19.8	Langwathby		27 36	51	26 47	56½
23.4	Culgaith		30 53	59⅓	30 38	64½
27.9	Long Marton		36 05	64½	34 51	63½
30.8	APPLEBY	39	39 00	55⅓	37 51	52⅔
33.2	Ormside		41 19	69½	40 20	64½
36.5	*Top of 1 in 100*		45 12	42⅔	44 39	37
38.3	Crosby Garrett		47 30	50	47 13	47
41.5	Kirkby Stephen		51 46	38	51 45	35
44.8	*Mallerstang*		57 23	32	58 03	27
			—	41	—	37½
48.3	Aisgill	68	63 03	32	64 35	27
51.4	Hawes Junc.		66 47	61	68 21	62½
59.5	*Blea Moor*	80	75 20	55	76 58	53
73.5	*Settle Junc.*	93	86 58	78*	89 14	76*
			sigs.		sigs.	
76.8	HELLIFIELD	97	90 13	—	92 21	
—			—	63½	—	61
86.8	SKIPTON	109	102 48	—	105 48	—
—			sigs.		sigs.	
102.1	Shipley (Bingley Junc.)	129	126 55		126 19	
—			—	63½	—	65
113.0	LEEDS	143	140 24		139 40	

*Max. speed between Blea Moor and Settle Junction

There is a gruelling start out of Carlisle, with 6 miles out of the first 8.4 inclined at 1 in 133, and in such conditions it was astonishing work by previous Midland standards, to pass Low House Box in 15¾ min. with a load not far short of 400 tons gross behind the tender. Then came the sharply undulating length on the wooded hillsides above the River Eden, where it makes so picturesque a course deep in the rocky gorges of Armathwaite and Barons Wood. Even with such hammering as was meted out to No. 1008 she could not, even with the 300-ton load, keep the sectional time to Lazonby, but on the downhill stretch to Lazonby itself, and on the gradual rise to Long Marton the initial loss of time was recovered—in fact, on the second trip, with the heavier train, the crew of No. 1008 were substantially improving on their efforts of the previous day.

Then, after the welcome respite afforded by the falling gradients from Appleby to Ormside viaduct, there comes the main ascent. There is 15 miles of it, though it certainly does include two appreciable breaks in the climbing. From a point near Griseburn signal box the 1 in 100 eases to 1 in 162, and this further eases to the crossing of Smardale viaduct, near Crosby Garrett. Then comes the worst pitch, a solid 5 miles of 1 in 100 through the wildest of moorland and mountain country, till Mallerstang Box is neared. The speed usually falls to its lowest figure anywhere on the ascent from Carlisle at the south end of Birkett tunnel, and at this point there is the welcome ¾-mile at 1 in 302 past Mallerstang before entering upon the final 3 miles at 1 in 100 up to Aisgill summit.

Magnificent though the work of No. 1008 was on her second trip, one could hardly expect her to maintain the lead over the 300-ton run in arduous mountain conditions, and the 350-ton trip had dropped down to level going at Kirkby Stephen, and fell behind to the extent of 1½ min. at Aisgill

Amid the beautiful scenery of the Peak District, a down Manchester express near Matlock hauled by No. 1047

summit. Even so, on a schedule planned for a 260-ton maximum load they were 3½ min. early passing the summit, with a 370-ton train. There was some brisk running down to Settle Junction on both trips, but by that time the train was close on the tail of the preceding express from Glasgow to St. Pancras, and signal checks prevented the making of any further fast time.

TABLE IV
PERFORMANCE OF ENGINE NO. 1008

Date	17/12/23	18/12/23
Load tons E/F	306/320	355/370
Average drawbar pull, tons	2.44	2.73
Max. D.B. pull on bank, tons	4.25	4.55
Max. Drawbar H.P.	954	1025
Locality of max. D.B.H.P.	one mile north of Appleby	near Langwathby
Speed at max. D.B.H.P. m.p.h.	57	59
Coal consumption per train mile lb.	42.4	46.2
per D.B.H.P. hr. lb.	3.93	3.83
per sq. ft. of grate area per hr. lb.	71.8	78.7
Water consumption gallons per mile	29.9	29.4
pounds per lb. of coal	7.05	6.37

The technical details of these two splendid runs are given in Table IV. Points that stand out are the very high maximum figures of drawbar horsepower registered, namely 954 and 1,025. The '999' class engine did not exceed 900 d.h.p. at any point, and the maximum with the L.N.W.R. 'Prince' was 965. Again the coal consumption per drawbar horsepower hour was very good for that period. It is doubtful if any British locomotives other than those of the Great Western could have improved upon it. But the figures of coal consumption also indicate that the engine was being very skilfully fired. The average rate for the entire trip of about 70 lb. per sq. ft. of grate area per hour is heavy, though this is not all. The hard work is finished by the time Blea Moor is passed, and by that time the train is little more than halfway from Carlisle to Leeds. The maximum rates of firing, namely, 131 and 146

lb. per sq. ft. of grate area per hour, give a more correct impression of the efforts demanded from the fireman.

With such running as that detailed in Table III there would be little let-up between Carlisle and Aisgill. In the last years of steam on British Railways a firing rate of 3,000 lb. of coal per hour was the maximum considered possible for a single fireman to maintain for any length of time. On a Midland compound this maximum would be equivalent to 106 lb. per sq. ft. of grate area per hour. It seems likely that this 'B.R.' maximum was substantially exceeded between Carlisle and Aisgill on these monumental tests of 1923-4, not only on No. 1008, but on both her competitors.

I have not been able to find any fully detailed logs of No. 1008's work northbound with 350-ton trains; but Table II gives a good impression of the performance on the critical section between Settle Junction, Blea Moor and Aisgill, and Table V shows the overall times on two of the runs.

On the first of these two runs the engine was handicapped on the climb to Blea Moor by having blown a high-pressure piston gland. On these northbound journeys the maximum drawbar horsepower generally occurred on the Blea Moor ascent, and on the second of the two runs a figure of 925 was registered just before entering Blea Moor tunnel. The values of coal consumption were generally the same as for the southbound runs.

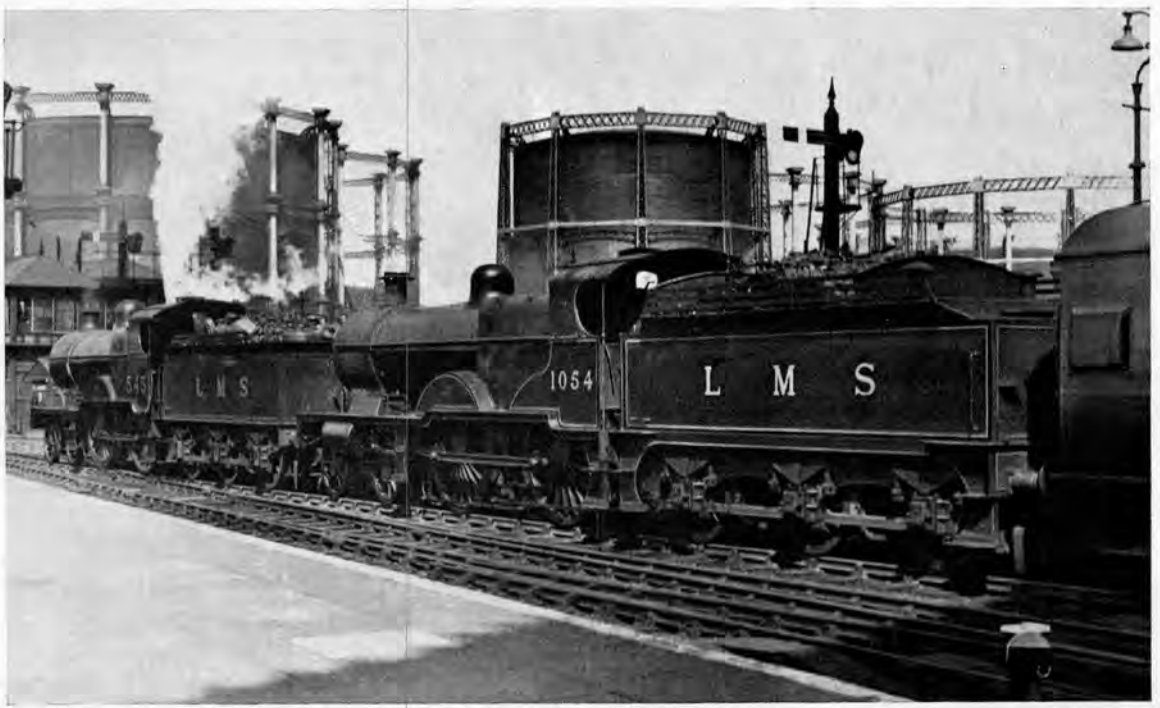
TABLE V

M.R. 4–4–0 No. 1008: 350-ton trains

LEEDS—CARLISLE

Dist. Miles		Sch. min.	Actual m. s.	Actual m. s.
0.0	Leeds . .	0	0 00	0 00
39.5	Settle Junc. .	51	51 55	50 16
53.5	Blea Moor .	73	77 16	75 31
64.7	Aisgill . .	86	91 26	88 24
113.0	Carlisle . .	135	138 07	133 24

Good though these trips with the 350-ton trains were, even No. 1008 could not keep strict point-to-point times on the mountain section; it was only by fast downhill running that the overall time was maintained. The schedule was of course 8 min. sharper than that of the southbound train. The log detailed in Table VI is therefore of interest as showing the speeds necessary to keep the uphill point-to-point times. From the overall performance



Engine No. 1054, with high-capacity railed tender, leaving St. Pancras on Manchester express, piloted by Class 2 superheater 4-4-0 No. 545

TABLE VI

L.M.S.R. 4.7 p.m. LEEDS—CARLISLE

Engine: 4–4–0 compound No. 1008
Load: 294 tons tare, 305 tons full

Dist. miles		Sch. min.	Actual m.	s.	Speeds m.p.h.
0.0	LEEDS	0	0	00	—
10.9	Shipley(Bingley Jc.)	15	16	08	
26.2	SKIPTON	33	33	41	
36.2	HELLIFIELD	47	47	11	
39.5	*Settle Junc.*	51	50	28	66
45.8	*Helwith Bridge*		59	06	35½/41
47.5	Horton		61	17	37½/39½
52.2	Ribblehead		69	00	34/37½
53.5	*Blea Moor*	73	71	12	33
61.6	Hawes Junc.		81	07	65½
64.7	*Aisgill*	86	84	18	52
82.2	APPLEBY	104	99	56	75 (max)
97.6	Lazonby		115	00	easy
113.0	CARLISLE	135	132	11	

point of view this was one of the finest of all the runs made by No. 1008, with its coal consumption of only 3.64 lb. per drawbar horsepower hour. The maximum d.h.p. registered was 902, while climbing the 1 in 100 between Horton and Ribblehead at 35 m.p.h. All three competitors were able to deal adequately with the 300-ton loads, but the compound did so with the greatest economy in fuel. The drawbar horsepower figures registered in these trials are probably a little on the high side. Four years later an examination of the Horwich dynamometer car revealed that the calibration was not correct, and this may have been the case also in 1923.

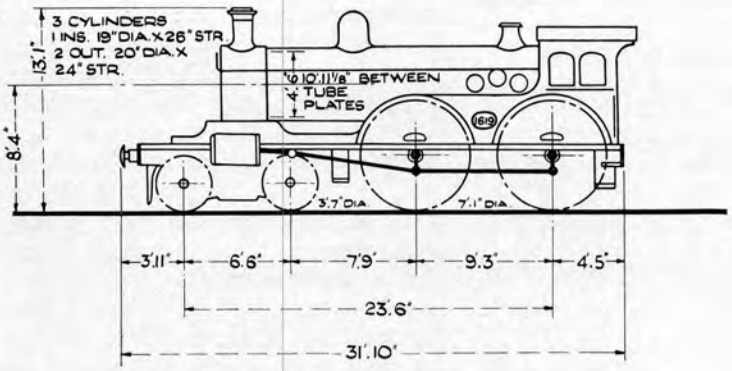
The official report includes some very interesting comparisons between the three engines in the form of some drawbar horsepower and speed curves, which are reproduced herewith. In studying them it is important to appreciate that they are based on the results of these trials alone, and do not necessarily represent the ultimate in performance of which the three engines were capable. So far as the two Midland engines are concerned, I think it may well be the ultimate; but the power curve for the North Western engine is more likely a reflection upon the technique of her driver, who was inclined to run very hard up the banks, and take things easily on the more favourable stretches of line. These curves do show, however, the clear superiority in power output of the compound over the '999', and they provided data that justified, in the eyes of the L.M.S.R. management, the preference they came to show for the Midland compound over the North Western 'Prince' as a general service passenger engine suitable for the entire L.M.S.R. system.

Even before the outcome of these trials was known, however, a series of 20 new compounds had been authorised, and beginning with No. 1045, in February 1924, Derby turned out these engines at the rate of one per week. By the time this order was well on the way to completion the report on the trials of December 1923 and January 1924 had been completed and digested, so much so that Derby was instructed to continue at once with a second batch of 20 compounds. The 1045-1064 batch differed from the original Midland engines in having 6 ft. 9 in. coupled wheels, and both the

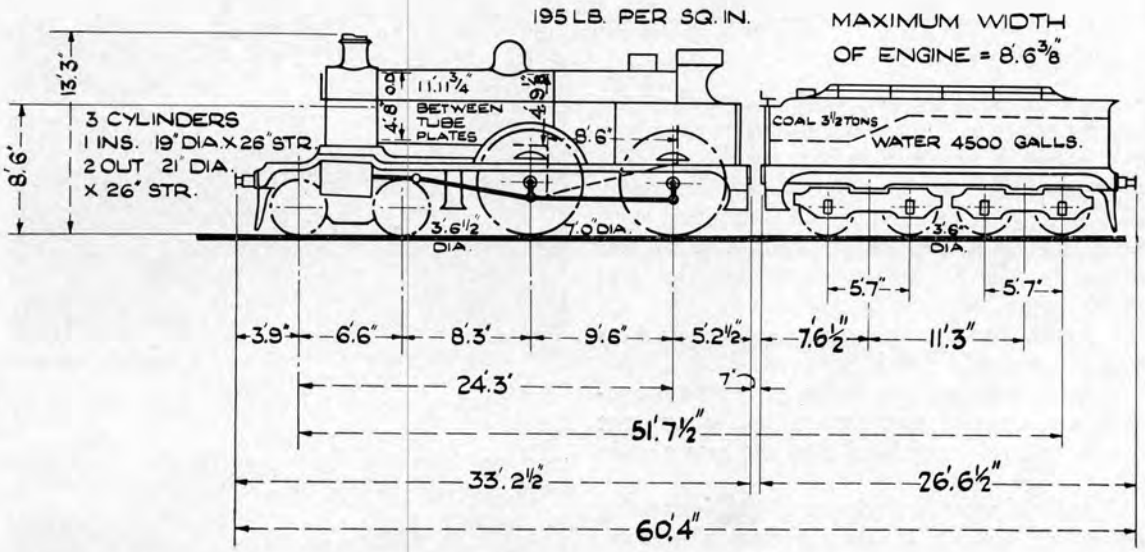
Derby—Bristol stopping train passing Halesowen Junction hauled by No. 1014

Nottingham—St. Pancras express passing Manton hauled by No. 1004

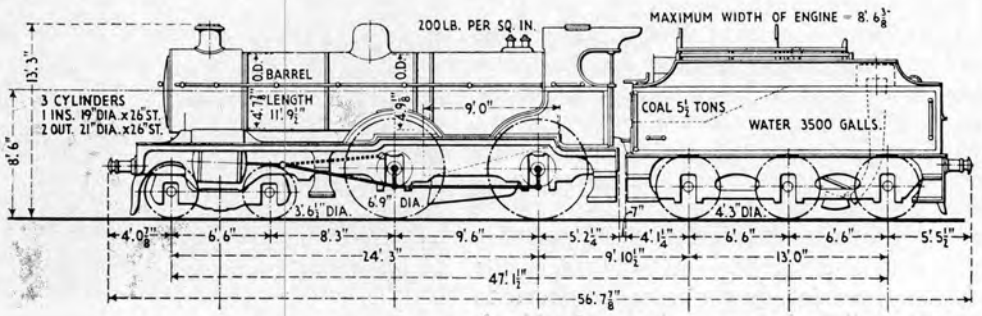
THREE-CYLINDER COMPOUNDS : A COMPARISON



N.E.R. Smith compound, No. 1619



M. R. Smith-Johnson compound, No. 2631



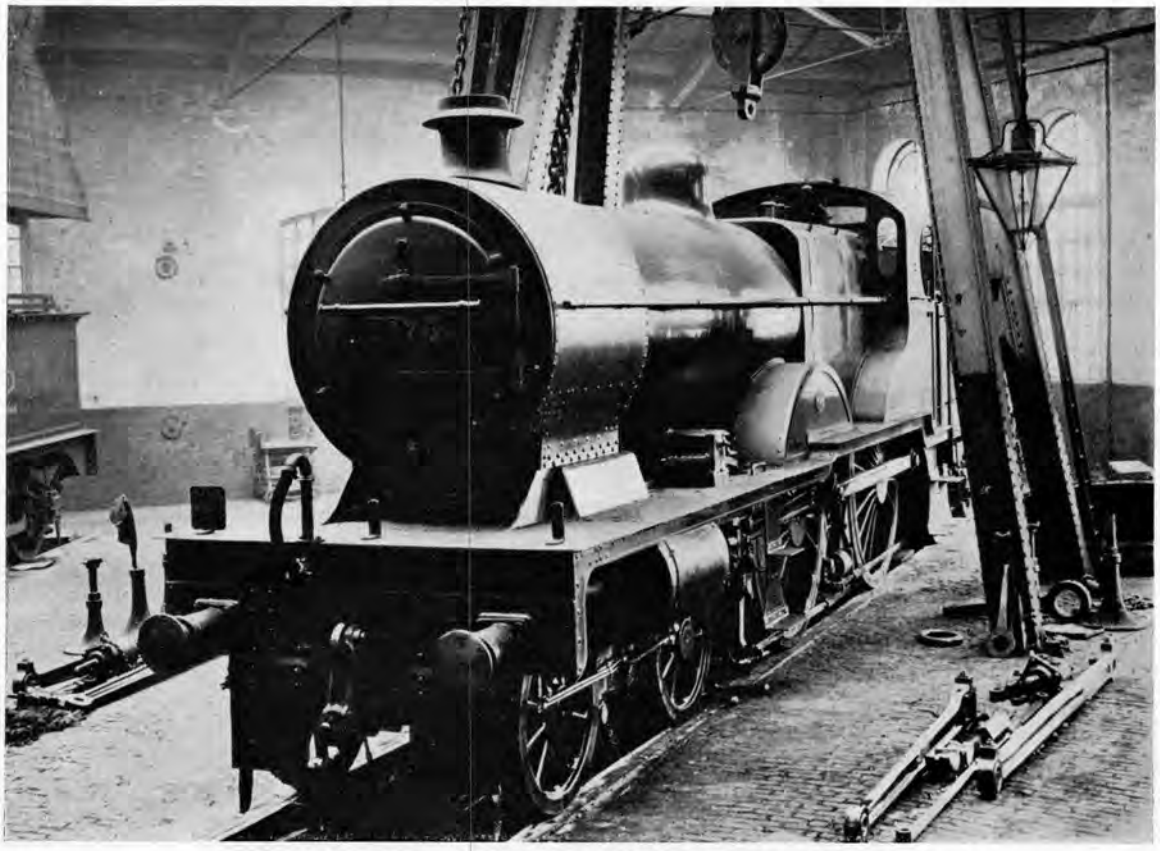
L.M.S.R. A standard Fowler compound

high-pressure and low-pressure cylinders were ¾ in. larger in diameter. Apart from their numbers these engines could be distinguished immediately from Nos. 1000-1044 by the shape of the dome cover. This was slightly flattened at the top, as on the Class 2 superheater rebuilds, whereas the original Midland engines had a very handsome rounded top to their domes. But the 1045-1064 batch were in every way true Midland engines, with Ramsbottom lock-up safety valves and the tall, characteristic Derby chimney.

By the time these engines took the road Midland influence was beginning to spread over the L.M.S.R. system in more tangible forms than that of organisation. J. E. Anderson, formerly Deputy Chief Mechanical Engineer of the Midland Railway, had been appointed Superintendent of Motive Power for the whole group. At that time he had never been known to speak well of any locomotives that had not been built at Derby, and he naturally began to consider the use of Midland engines on other parts of the line.

The two-hour Birmingham expresses of the former L.N.W.R. seemed to him an ideal place to use the Derby compounds. In the years 1923-4 some of these fast trains loaded to no more than 6-coach formations, and trials were made not only with compounds but with a Midland rebuilt superheater Class 2 4—4—0. The latter engine and a standard 7 ft. compound No. 1033 were worked by Kentish Town men, with a North Western pilotman. It was not altogether surprising that a Class 2 proved barely able to manage a task regularly allotted to the 'George the Fifth' class 4—4—0s; but the work of the compound No. 1033 was encouraging to the extent that when the 1924 batch of compounds was turned out from Derby works, six of them, Nos. 1051-6, went new to Camden and duly began to take their turns on the Birmingham expresses.

In other respects, however, motive power matters were not being handled very skilfully from a personal point of view; and when changing of organisation was followed by the planting of the Midland engines in their midst, the resentment of the North Western men began to build up into a situation that



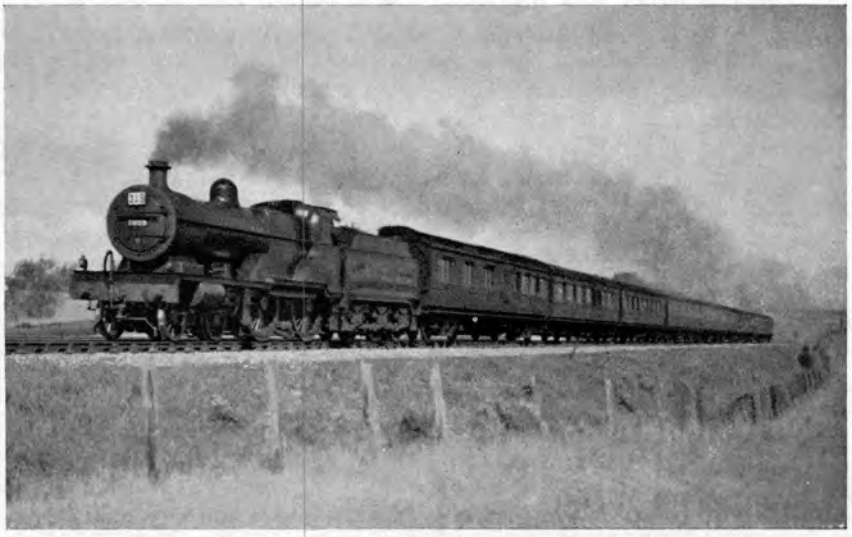
Engine No. 1078, undergoing some light repair in Derby running shed

Down stopping train near Duffield, hauled by No. 1022

One of the short-chimneyed series, with right-hand drive, No. 1075, attached to the new stock for the St. Pancras—Bradford service

could have become catastrophic for the business of the Company. If there had been any deficiency in the available motive power on the Birmingham expresses it would have been another matter. But the 'George the Fifths' were doing particularly well, and with train loads rarely exceeding 300 tons they were very much on top of the job.

Although they tended to get rough as mileage after the last general repair mounted up, the North Western men were used to this and appreciated their reliability in traffic and their free steaming. Moreover, by the standards of the day they were by no means extravagant on coal. When newly out of the shops their coal consumption per drawbar horsepower hour was probably lower than that of any engines running in the country, other than those of the Great Western. By an engineman's standard of comparison the Midland compounds were certainly no better—if as good—and there seemed no virtue in changing. The substitution of Midland engines for their own had every evidence of a political move rather than one dictated by practical railway considerations, and for a time a sustained attempt was made, both overtly and covertly, so to tarnish their reputation as to secure their removal from the links. If other sections of the L.M.S.R. had taken the same stand the history of the Midland compounds might have been very different; but developments were taking place in the north that eventually turned the flank of the North Western.



North to West express, composed of G.W.R. stock, near Abbots Wood Junction, hauled by engine No. 1029

CHAPTER 6

DYNAMOMETER TRIALS, SETTLE AND CARLISLE LINE, 1924-25

The excellent results achieved with engine No. 1008 in the first set of pre-grouping trials over the Settle & Carlisle in 1923-4 undoubtedly prompted the decision to follow the 1045-64 batch of compounds with another series of 20, and in these, with a view to their use on all parts of the L.M.S.R. system, the boiler mountings were cut down to conform with the loading gauges of the Scottish constituents of the group. The new engines, Nos. 1065 to 1084, completed at Derby in the summer and autumn of 1924, were otherwise built entirely in the Midland tradition, with right-hand drive—another very sore point among the North Western men. At that time, too, engines and tenders continued to be paired. The engines carried the number on the smokebox door and the L.M.S.R. heraldic device on the cab sides; the engine number was also carried in large figures, Midland fashion, on the tender. It is extraordinary for how long this inconvenient arrangement survived, and the number of engines seen without their own tenders was appropriately high.

Minutiæ apart, however, those in command of the locomotive department had, by the summer of 1924, developed such a superiority complex where the compounds were concerned that they seemed ready to back them against all comers. Use of them in Scotland was already envisaged, and in the late autumn of 1924 a further series of trials over the Settle & Carlisle line was organised, in which compounds would be tested against Caledonian 4—4—0s and North Western 4—6—0s. Although in the earlier trials the going had been fairly close, so far as power output was concerned, between the compound and the North Western 'Prince of Wales' 4—6—0, Derby were evidently convinced of the overwhelming superiority of their own engine; and in November 1924 they decided to challenge one of the much larger and heavier 'Claughton' class 4—6—0s of the L.N.W.R on equal terms—equal, that is, so far as haulage tasks set to the competing locomotives were concerned.

On paper the trials seemed unequal from the start, for whereas in the earlier series, in 1923-4, the engines engaged were all 'Class 4', in the November and December trials of 1924 the compounds were matched against a 'Class 5' 4—6—0 and a 'Class 3' 4—4—0 simple from the Caledonian. Events contrived to make the trials unequal in other respects too.

As in the previous trials the trains concerned were to be the 12.10 p.m. from Carlisle to Leeds and the 4.3 p.m. down. Since the time of the first series the latter train had been retimed to include a stop at Hellifield. The engines and men concerned were based on Durran Hill shed, Carlisle, and this introduced a factor that in November 1924 considerably affected the results and led to a lot of wrong conclusions being drawn. The West Coast main line, despite the introduction of a number of new Lancashire & Yorkshire four-cylinder 4—6—0s, was very short of engine power. The L.M.S.R. authorities had reduced drastically the maximum tonnages that could be taken unassisted, not only over Shap, but throughout between Euston and Carlisle. The result was an enormous amount of double-heading and a shortage of engines in consequence. The North Western shed at Carlisle could not spare a 'Claughton' for trials over the Midland line to Leeds, and so Edge Hill shed was instructed to transfer one of its own stud. Whether the shedmaster was told why, I cannot say, though from subsequent events I very much doubt it.

When one shed is instructed to part with one of its engines to another depot it is no more than human nature to send the worst that will comply with the instructions, and on November 19 Edge Hill transferred No. 2221, *Sir Francis Dent*. This

engine had been out-shopped at Crewe in July 1924 after a general repair. It was then worked hard for those days, averaging 6,000 miles a month, before it was sent to Carlisle. The driver and fireman who were to work it in the trials made two return trips with it from Carlisle to Leeds in the following week, and then on December 2 came the first of the dynamometer car trials. The diary of this particular series of tests reads as follows:

Date	Engine No.	Load (nominal tare) tons
November 18	1065	300
,, 19	1065	300
,, 20	1065	350
,, 21	1065	350
,, 26	C.R. No. 124	300
,, 27	1023	350
,, 28	1023	350
December 2	2221	300
,, 3	2221	300
,, 4	2221	350
,, 5	2221	350
,, 9	1066	300
,, 10	1066	350

The Caledonian engine was completely outclassed and apparently one return trip was enough to show that she was not up to the haulage of 300-ton trains, let alone anything heavier. The 'Claughton' steamed badly throughout, and although the engine had sufficient reserve of power for the driver to work these trains to time the record of coal consumption suffered in consequence, and the results were not representative of the class as a whole. It will be seen, however, that three different compounds were used at different times, two being of the new short-chimneyed series, and one a standard Derby 7 ft. superheater engine.

It is the work of the compounds, however, that is of the greatest interest, particularly when compared to the results achieved with No. 1008 roughly a year earlier. These engines were gaining a reputation for being the most economical on the entire L.M.S.R. system, and in discussing the results of November-December 1924 it is, from the outset, worth looking at the bald results tabulated in terms of coal consumption per drawbar horsepower hour, and nothing else. The three engines in these later trials showed very consistent results on this basis alone, all considerably above the best results recorded with No. 1008 a year earlier. It is a rather sobering reflection to compare the consistent results from three different Midland compounds with those from the North Western 'Prince of Wales' No. 388, in 1923, for it was on the basis of the superiority of No. 1008 over No. 388 that the Midland case for

One of the original 6ft. 9in. compounds, No. 1056, on a down L.N.W. section express near Kenton

the multiplication of the compounds was based.

The North Western figures in December 1923 were far more consistent than those obtained with No. 1008, and on the five return trips the values of coal consumption per d.h.p. hour, in pounds, were: 4.43, 4.77, 4.52, 4.62, 4.31, 5.12, 4.31, 4.97, 4.39 and 4.67. The average works out at 4.60 against the average of eight Midland compound trips in November and December 1924 of 4.45. To anyone familiar with the variations in coal consumption inherent in road trials with the dynamometer car, on service trains, the difference between the 'Prince of Wales' and the Midland compounds would be negligible. But when official comparison between the two classes was made it was with the very exceptional No. 1008 that the 'Prince' was contrasted.

MIDLAND COMPOUND TESTS
LEEDS—CARLISLE

Date	Engine	Load (nominal tare tons)	Coal lb. per D.H.P. hr. Up	Down
17/12/23	1008	300	3.93	3.64
18/12/23	1008	350	3 83	3.73
19/12/23	1008	350	4.02	—
19/12/23	1008	221	—	4.22
20/12/23	1008	300	4.02	—
20/12/23	1008	227	—	4 5
31/12/23	1008	350	3.71	—
31/12/23	1008	249	—	3.94
15/ 1/24	1008	350	3.7	3.9
18/11/24	1065	300	4.46	
19/11/24	1065	300	4.39	
20/11/24	1065	350	4.33	
21/11/24	1065	350	4.45	
27/11/24	1023	350	4.45	
28/11/24	1023	350	4.42	
9/12/24	1066	300	4.68	
10/12/24	1066	350	4.43	

Moreover, the coal consumption figures alone do not tell anything like the full story of the November and December tests of 1924. Engines 1065 and 1066 were both relatively new; they had the larger cylinders and 6 ft. 9 in. coupled wheels of the post-grouping engines of the 1045-1084 series, whereas No. 1023 was a standard 7 ft. superheated example of the Midland Railway Deeley series, by all ordinary reckonings identical to No. 1008. All three compounds had run roughly 14,000 miles since leaving the shops; in the case of 1023 this was, of course, from the last general repair. The new engines 1065 and 1066 both did well, and their uphill running will be discussed in more detail later; but No. 1023 put up a consistently shocking performance on the banks. Against a schedule of 67 min. from Carlisle to Aisgill she took 76 min. 49 sec. on her first trip with 350 tons, and 74 min. 55 sec. on the second; these efforts were followed up by losses of roughly another minute in each case from Aisgill to Blea Moor, thus totalling losses of 11 min. and 9 min. from Carlisle to Blea Moor. Against these totals by No. 1023 of 89 min. 47 sec. and 87 min. 53 sec., engine No. 1008 a year earlier had made times of 76 min. 54 sec., 78 min. 59 sec., 79 min.

Engine No. 1056 on down Manchester express near Kenton —train all in L.N.W.R. livery

Date	Engine	Actual load tons tare	Running times Settle Jc. Blea Moor m. s.	Blea Moor Aisgill m. s.	Min. sp. m.p.h.	Max. D.P. tons	Max. E.D.H.P.
18/11/24	1065	311	25 00	13 33	26	3.93	769
19/11/24	1065	324	23 35	13 45	28	4.08	857
20/11/24	1065	361	25 47	14 29	25	4.5	829
21/11/24	1065	353	28 28	14 27	22½	4.6	758
9/12/24	1066	305	23 05	15 59	30	3.75	870
10/12/24	1066	347	23 58	14 15	28½	4.26	906

Compound No. 1191 piloting an L.N.W.R. 'Claughton' 4-6-0 on down express near Kenton

36 sec., and 79 min. 54 sec. on the four runs she made with 350-ton trains.

The coal consumption figures obtained with engine No. 1023 do not therefore strictly relate to the same job, for she was in effect running to a slower schedule. The coal consumption figures for the trials of November-December 1924 do not distinguish between the southbound and the northbound trips, but No. 1023 was no more successful on the 4.3 p.m. down from Leeds to Carlisle.

Against a schedule of 22 min. from Settle Junction to Blea Moor, and of 13 min. onwards to Aisgill, this engine, hauling 350 tons tare, took 35 min. 2 sec. and 31¼ min. over the first section, and 16 min. 58 sec. and 15 min. 35 sec. over the second, total losses of 17 and 11¾ min. over this critical uphill section. The official report, in justifiably praising the work of engines 1065 and 1066, almost completely glosses over the serious failure of No. 1023 to do the job, and the only other comment, other than a note that she was slipping considerably at various points, is to the effect that the low-pressure cylinder steam chest drain valve was leaking on the northbound runs. Cecil J. Allen was a passenger in the train on the second northbound run of No. 1023, and he afterwards expressed the opinion that an increase in tare load from 300 to 350 tons had rather overtaxed compound capacity, as an all-weather figure. It is certainly true that they struck a very wet and windy evening, though the engine was reported to be steaming quite satisfactorily.

The work of the new compounds 1065 and 1066 can best be exemplified from the climbing from Settle Junction to Blea Moor, and on the tableland section onwards to Aisgill.

As previously mentioned, the scheduled times over the mountain section were 22 and 13 min. respectively so that on no occasion did either engine maintain strict time. On the other hand, the timings were laid down for a load of 260 tons tare, and on November 20, for example, with 361 tons behind the tender the gross trailing load would probably have been 380 or even 385 tons—a tremendous load for a 4—4—0 engine in such conditions. North Western enthusiasts will no doubt recall that in days prior to World War I tare loads of 360 to 370 tons were taken unassisted by 'George the Fifth' type 4—4—0s over Shap, and that with such tonnages speeds were rarely down as low as 30 m p.h. at Grayrigg summit after a 13-mile climb. On the Midland even the brilliant 1008, in 1923, did not

Engine No. 1054, with high capacity railed tender, climbing Camden bank

manage a better time, with 350 tons, than 25¼ min. from Settle Junction to Blea Moor. By the end of the year 1924, therefore, the run of December 10 by No. 1066 stands out as the best ever, and this is reflected in the figure for the equivalent drawbar horsepower. On such work was based the justification for building many more new compounds. These engines had slightly different boilers from the Deeley engines, thus:

Heating surface:	Tubes	1169.7 sq. ft.
	Firebox	147.3 sq. ft.
	Superheater	290.7 sq. ft.

At a later stage the heating surface of the superheater was still further reduced to 272 sq. ft.

At the same time it is evident that the authorities at Derby were not wholly convinced that the new engines with their 19¾ in. high-pressure cylinders and 21¾ in. low-pressure cylinders were the complete answer. On occasions of heavy workings drivers had been 'beating the boiler', and in February 1925, having disposed of foreign competition, as it were, the 'welkin' of the Settle & Carlisle road once again rang to the music of heavy dynamometer car test runs, but this time it was purely a domestic affair of the Midland Division of the L.M.S.R. Two of the new standard compounds, carrying different experimental modifications, were run against each other on the same two trains. The modifications were:

Engine No. 1060, fitted with a reduced diameter of blast pipe cap (4½ in. instead of 4¾) and a petticoat fitted to the underside of the chimney.

Engine No. 1065, with cylinders lined up to the former diameter of 19 in. and 21 in., thus becoming exactly the same as the superheated Deeley engine, except that the coupled wheel diameter was 6 ft. 9 in. instead of 7 ft.

The Midland compounds had always been good steaming engines, and the reduction of the diameter of the blastpipe orifice on engine No. 1060 made that engine steam very freely indeed. Equally, from the test results I have already discussed it will be appreciated that No. 1065 as built, with 19¾ in. and 21¾ in. diameter cylinders, was an exceedingly strong and successful engine. In the report on these trials of February 1925 complete details are given of the boiler pressures maintained throughout the uphill sections, and the actual regulator and revers-

ing gear positions. From these details one thing immediately stands out, and earns this comment in the report: 'From the footplate observations engine No. 1065 was able to work both the 300 and the 350-ton trains with less regulator and less cut-off than engine No. 1060.'

If other things were equal that would appear to be a very curious result. As engine No. 1065 had the smaller cylinders one would expect the exact opposite, and one is led to believe that 'other things' were not equal! Under the heading 'Running Times', the report has this comment: 'Engine No. 1065 was generally able to gain time on the heaviest parts of the road with both the 300-ton and the 350-ton trains, and undoubtedly gave the better all-round performance of the two engines.'

One or other of the reversing scales may not have been accurately calibrated, so that the cut-offs were greater or less than the values indicated. But this is perhaps too easy a suggestion to make; the fact that both engines had been prepared for test conditions might have involved an examination on this point. Another explanation is that the restriction of the blastpipe orifice on engine No. 1060 may have so restricted the exhaust as to require the use of a wider regulator opening and longer cut-off to overcome this resistance. Qualitatively this might well be so, but hardly to the extent of neutralising the advantage of cylinders larger in diameter by $\frac{3}{4}$ in., and enabling No. 1060 to do the job on a shorter cut-off into the bargain. Whatever the true explanation was, the fact remains that No. 1065 was lighter on coal. The figures for coal consumption per drawbar horsepower hour on the six round trips were:

Date	Engine	Load tons tare	Coal per D.H.P. hr. lb.
23/2/25	1060	300	4.72
24/2/25	1060	300	4.65
26/2/25	1065	300	4.22
27/2/25	1065	300	4.18
25/2/25	1060	350	4.77
28/2/25	1065	350	4.15

It is worth noting that in the trials in the previous November the coal consumption of No. 1065 had varied between 4.33 and 4.46, so that the effect of putting on smaller cylinders was slightly to reduce the coal consumption. In saying this, however, I am, admittedly, speaking academically. In road trials of this kind with service trains, in wintry weather conditions, many factors can enter in to affect the results profoundly. In the case of engine No. 1065 the surprising thing is that the coal consumption figures were so consistent. The sectional times are quoted in greater detail in this report than in the case of earlier tests over this route, and the logs of two of the three runs with engine No. 1065 are worth quoting.

Engine No. 1134 on up Manchester express on the North Staffordshire line

Run No.		Sch.	1	2
Date			26/2/25	28/2/25
Loads tons E/F			299/320	352/375
Dist. miles		Sch. min.	Actual m. s.	Actual m. s.
0.0	Leeds	0	0 00	0 00
10.7	Shipley (Leeds Jc.)	15	15 25	15 58
17.0	Keighley	22	22 53	23 43
26.2	Skipton	33	31 30	33 56
36.2	Hellifield	48	45 54	47 56
9.0		0	0 00	0 00
3.3	Settle Jc.	5	4 54	4 50
17.3	Blea Moor	27	25 40	28 13
28.4	Aisgill	40	38 03 p.w.s.	41 45 p.w.s.
46.0	Appleby	58	53 52 p.w.s.	59 19 p.w.s.
76.8	Carlisle	90	86 24	91 38

On the two trips the corresponding engine working on No. 1065 is given at each intermediate point, and I have set out these results over the mountain section from Hellifield to Aisgill in a separate table. The cut-off figures quoted are those of notches in the reversing gear. The corresponding cut-offs in the high and low-pressure cylinders are given separately.

L.M.S.R. ENGINE No. 1065
HELLIFIELD—AISGILL

Station	Boiler Pressure lb. per sq. in.		Regulator opening		Notch of reversing gear	
	26	28	26	28	26	28
Settle Junc.	200	200	¾	full	6	7
Settle	204	200	full	full	6	7
Horton	200	200	full	full	7½	8
Ribblehead	202	195	full	full	8	9
Blea Moor	205	195	full	½	8	6
Dent	190	190	⅔	½	6	6
Aisgill	195	190	⅓	½	6	6

Numbers 26 and 28 refer to the date in February, 1925.
Min. speed on bank: February 26 — 33 m.p.h.
„ 28 — 26 m.p.h

The cut-offs corresponding to the various notch positions of the reverser are as follows:

Notch	H.P. cut-off %	L.P. cut-off —	Equivalent cut-off Simple engine %
6	67	55½	27½
7	71	61	29½
7½	73	64	30¼
8	75	66½	31
9	79½	72	32½

The performance of engine No. 1065 on these trials was subjected to an analysis of a different kind in a paper read before the Graduates' section of the Institution of Mechanical Engineers in 1926 by Mr. E. L. Diamond, who was a pupil at Derby during the time the trials were in progress. He carried out an investigation into the cylinder losses occurring in the locomotive while working on service trains over a route of considerable fluctuating gradients. Although Diamond was then on the staff of Sir Henry Fowler this analysis was not carried out as part of his official duties, but was a personal investigation undertaken largely for the purpose of a paper to the Institution of Mechanical Engineers.

Although it was originally an independent effort by a keen young engineering graduate the situation it revealed was so interesting, and so disconcerting, that a remarkable correspondence ensued, in which locomotive engineers of the eminence of Monsieur Bréville of the Northern Railway of France, Mr. L. K. Sillcox of the Pennsylvania, Professor Edouard Savage, and Mr. Lawford Fry took part; and at the original reading of the paper in London that great enthusiast Loughnan Pendred, then Editor-in-Chief of *The Engineer*, was in the chair, supported by

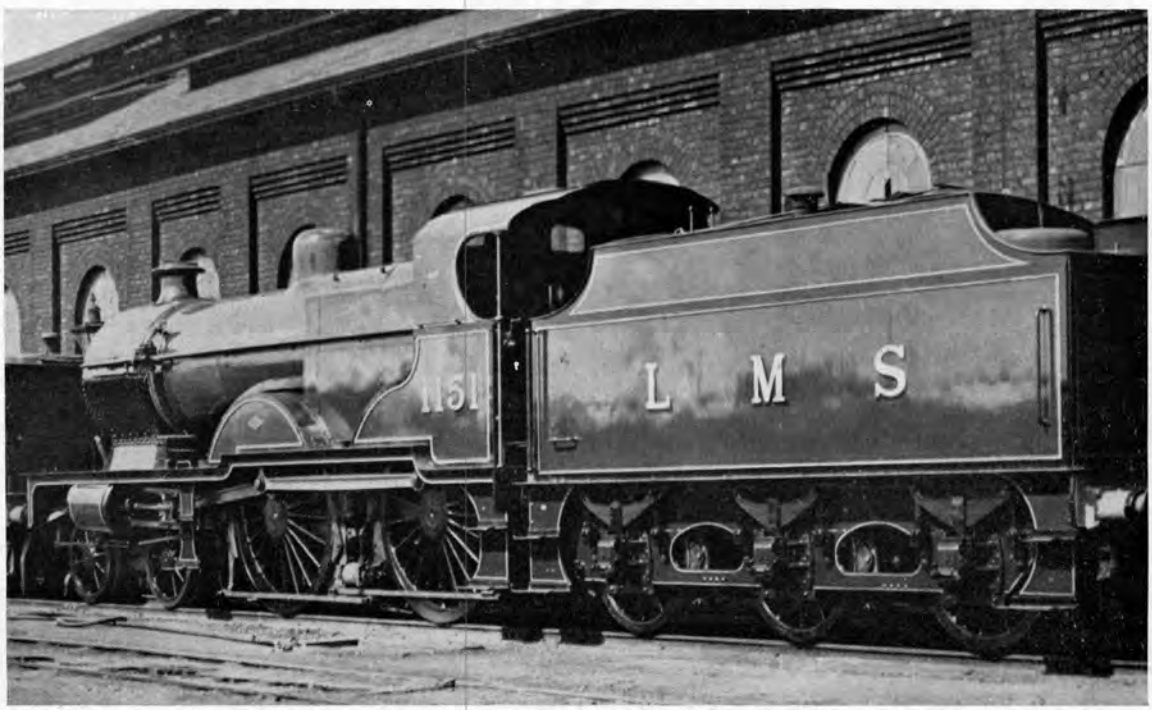
The cab of a standard left-hand drive compound (No. 1197)

Bristol—Derby stopping train climbing the Lickey Incline, with 0-6-0 bank engine in rear. Engine No. 1097

Mr. H. Holcroft of the Southern, and Sir Henry Fowler himself. It certainly was a galaxy to find at no more than a Graduates' meeting of the Institution.

In his introduction Diamond explained: 'The object of this investigation is to ascertain what proportions of the available energy of the steam between boiler and atmospheric pressures are accounted for by the various known sources of loss in the engine, and to discover the relationship between the variation of these losses and the conditions under which they occur. It is necessarily confined to the study of one particular locomotive, but, if only on account of the differences in the performance of various types, the results herein set forth should be regarded as an indication of an extensive field of research.'

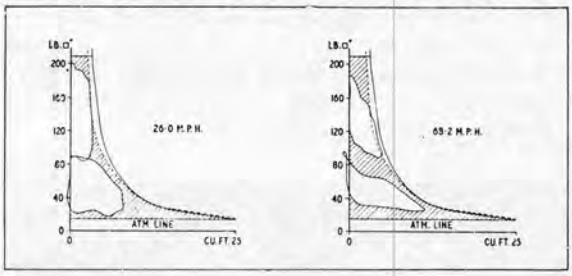
It is particularly interesting that this piece of research work should have taken place after engine No. 1065 had been modified, with the cylinder diameters each reduced by $\frac{3}{4}$ in. In this investigation 28 sets of indicator diagrams were selected to represent, in fair proportions, the varying conditions of running on the Leeds—Carlisle road, as follows:



After general overhaul at Derby, No. 1151

Speed m.p.h.	Percentage of Total work done	Number of diagrams selected
0—30	4.6	3
30—40	28.1	9
40—50	27.2	7
50—60	25.6	5
Over 60	14.5	4

From the diagrams taken off the cylinders at speed the high-pressure and low-pressure diagrams were re-drawn to the same scale, so that the usage of steam during the whole range of expansion could be studied. The actual indicator diagrams, the area of which represented work done, could thus be compared on the combined diagram with the theoretical capacity for work in the steam admitted to the high-pressure cylinder. Two typical combined diagrams are reproduced here, taken at 26 and 68¼ m.p.h.—both with the engine working in the 6th notch of the reverser. The losses are represented by the shaded areas, and it will be seen at once that these are much larger at high speed.



In his penetrating analysis Diamond showed where these losses were occasioned:

(a) Loss due to pressure drop between boiler and steam chest.
(b) Loss due to throttling at admission.
(c) Loss due to clearance.
(d) Loss due to heat exchange between steam and cylinder walls and leakage.
(e) Loss in the intermediate receiver, between the high and low-pressure cylinders.
(f) Loss due to incomplete expansion.
(g) Loss due to throttling and back pressure.

By far the most serious losses are those coming under headings (b) and (g). On this particular engine they were not unduly large at low speeds, but at speeds of between 60 and 70 m.p.h. they were shown in this investigation to rise to almost unbelievable heights. At 68 m.p.h. working in the 6th notch the engine developed an output of 800 horsepower, performing useful work in hauling the train; but such were the losses that 200 horsepower was lost in throttling at admission, and another 200 in exhaust throttling and the overcoming of back pressure.

Diamond summed up his paper thus: 'Several outstanding facts are made clear by this investigation. The first is that as great a loss of efficiency occurs in the cylinders as in the boiler of the locomotive, particularly at high speeds. In express passenger service the locomotive runs normally at speeds in excess of fifty miles an hour. Under these conditions the boiler efficiency may be from 60 to 70 per cent. or more, but the relative engine

In early L.M.S.R. days, No. 1150 climbing Camden bank with a heavy down express, including many coaches still in L.N.W.R. livery

efficiency will not exceed 60 per cent. in the best designs of locomotive with the traditional form of valve gear. It would seem, therefore, that an insufficient proportion of the attention of locomotive designers has been directed to the engine as distinct from the boiler, and it is suggested that great improvements can be made in this direction which would also assist in solving the boiler problem by reducing the steam consumption per drawbar horsepower hour.

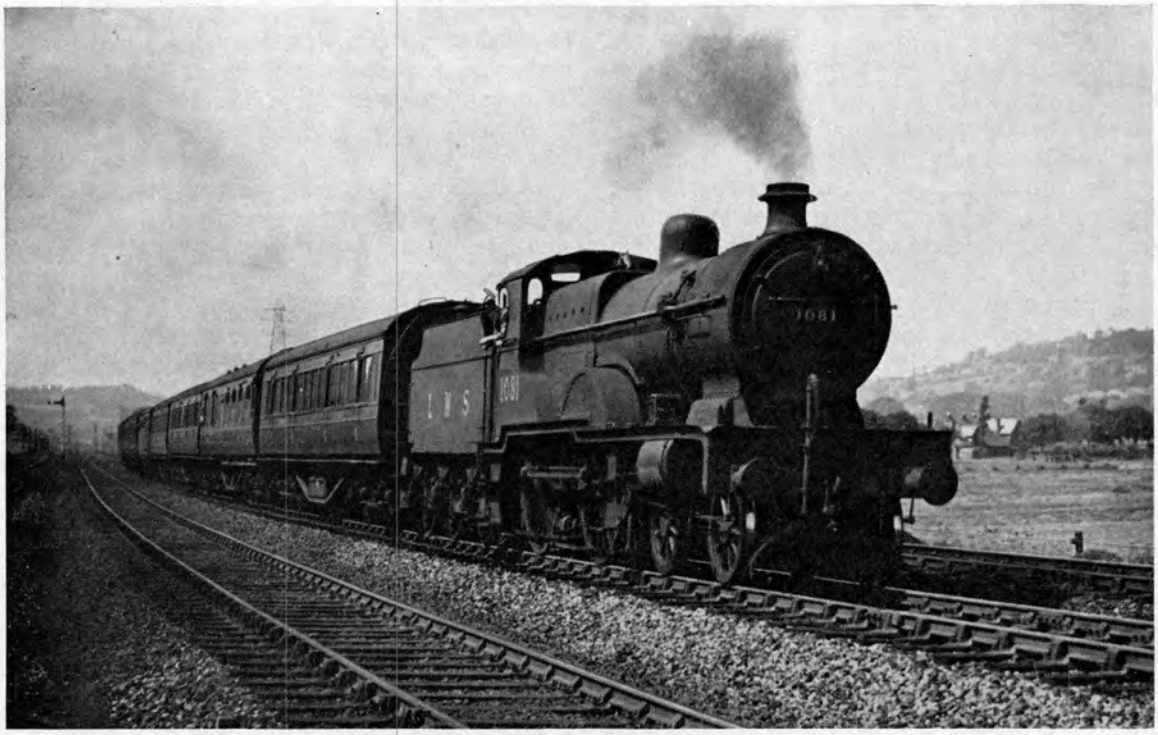
'It is also an important fact that the cylinder losses increase with the speed, and this helps to explain why goods engines run more efficiently than passenger engines. So great, in fact, is the increase in throttling and back pressure losses at express speed that it is to be recommended strongly that locomotive tests be not confined, as is so often done, to very heavily graded routes, but that tests be made on level or easily graded routes with maximum train loads and at high average speeds. Far greater differences are likely to be found between different types of locomotives under these conditions, and it is, perhaps, not without significance that the one British railway company which has standardised the long-lap valve for years past is the railway whose main line is level and whose trains are scheduled at the highest average speeds.'

There is no doubt that the carrying out of the comparative tests among various locomotives of the L.M.S.R., first over the Leeds—Carlisle route, and then, as will be discussed in the next chapter, between Preston and Carlisle, favoured the Midland compounds. They were at their best and most efficient slogging uphill at 30 to 40 m.p.h. When required to steam hard at 65 or 70 m.p.h. it was noticeable how they seemed, to outside observers, to choke themselves. The drivers had found that a little easing back of the regulator would enable them to run more freely. Diamond's investigation showed clearly why this was so. I was present at the meeting when the paper was first read, and I can remember to this day, when Diamond came to his recommendations, how Sir Henry Fowler sat bolt upright. Diamond said:

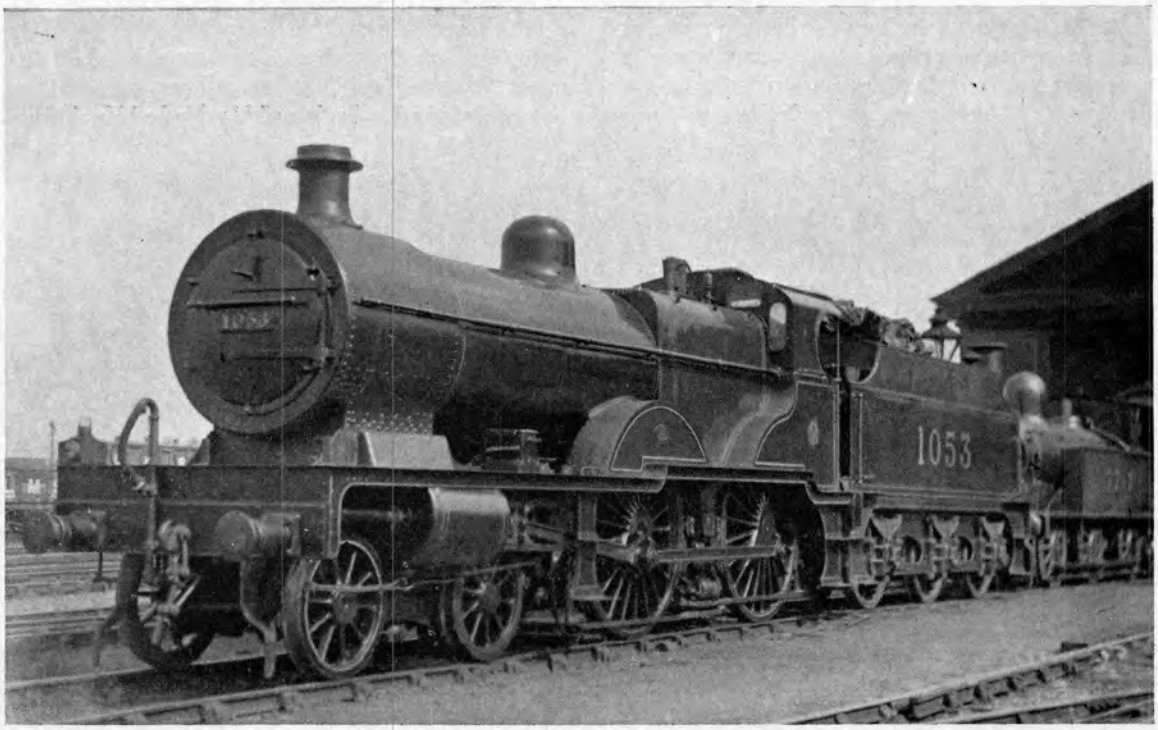
'Perhaps the most important fact of all those set forth is that in the cylinders of the locomotive under investigation, which is known to be of high efficiency, the total losses due to the restricted passages given to the steam at admission and exhaust increase from 17.6 per cent. at 24 miles an hour to no less than 67.6 per cent. at 68 miles an hour, of which probably not more than 15 per cent. is necessary for the production of draught; that is to say, *an amount of power equal to half the work that is actually being exerted on the train is wasted in throttling losses at this speed.* In view of this fact the Author unhesitatingly recommends the universal adoption for compound as well as simple-expansion locomotives of the long-lap valve by means of which the port opening to steam at admission and exhaust can be materially improved.'

Such a forthright statement might have seemed a little presumptuous from a young man not long out of his pupilage; but at the time he read this paper Diamond had left the railway, and was on the staff of the Institution of Mechanical Engineers.

Combined Glasgow and Edinburgh to St. Pancras express leaving Carlisle: compound No. 1071 piloted by Class 2 superheated 4-4-0 No. 412



Morecambe to Leeds stopping train near Keighley, hauled by No. 1081



At Camden shed, in early L.M.S. days, No. 1053, used regularly on the Birmingham expresses

Anyway, Fowler was so interested in these conclusions that he asked leave to take the manuscript of the paper back to Derby with him. The design for the new 2—6—4 tanks of the '2300' class was then on the drawing board, and after one look at the valve motion Fowler told his chief draughtsman to scrap that part of it, and re-design it, using long-lap, long-travel valves. The result, in the '2300' class, was one of the fastest and most efficient engines ever to run on L.M.S.R. metals. Whether or not consideration was ever given at Derby to the rebuilding of any of the compounds with long-travel valves I do not know; but no such change was actually made and the engines remained restricted at high speed throughout their long life.

In connection with this it is very interesting to read, once again, the comments of Herbert Chambers, then Chief Locomotive Draughtsman at Derby, in a notable contribution to the discussion on Diamond's paper. He wrote that:

'The paper contained much that was interesting to him on account of his close association with the standard three-cylinder compound engines that the Author had chosen for his investigation. The Author indicated that he was a strong advocate of the "long-travel valve" and undoubtedly the case put forward, particularly with regard to the restriction of port opening with a short-travel valve at express speeds, deserved careful consideration. Although the steam-port opening was considerably improved when a long-travel valve was adopted, the more important advantages were derived from the greatly increased opening of the exhaust port which permitted freer exit of the exhaust and must therefore result in increased efficiency due to a reduction in back pressure.

'The suggestion that locomotive tests should be carried out over level sections of the road brought forward the different methods of working an engine under conditions of easy gradients and heavy gradients. On easy gradients the engine would be working hard continuously, whereas on heavy gradients it would work very heavily and ease off intermittently, assuming always that it was loaded up to its maximum capacity.

'The practical results of the first case were that the engine had little or no reserve, and any defect that developed, such as dirty tubes, must therefore greatly affect the steaming and general performance. In the second case, intermittent heavy working gave a chance for the blast to clear the tubes, and when working light, to recuperate for the next heavy spell. It should not be forgotten, however, that a combination of the two sets of conditions might occur, and the worst proposition would be a long run on the level followed by a stiff climb. The finish of the run in this case would have to be performed with the engine in a poor condition.'

The steaming trials of February 1925 on the Settle & Carlisle road between engines 1065 and 1060 certainly set off this particular investigation. They also determined the future standard dimensions of the compounds. One could appreciate the decision to reduce the cylinder diameters following

Engine No. 1039 entering St. Pancras with a stopping train from Leicester

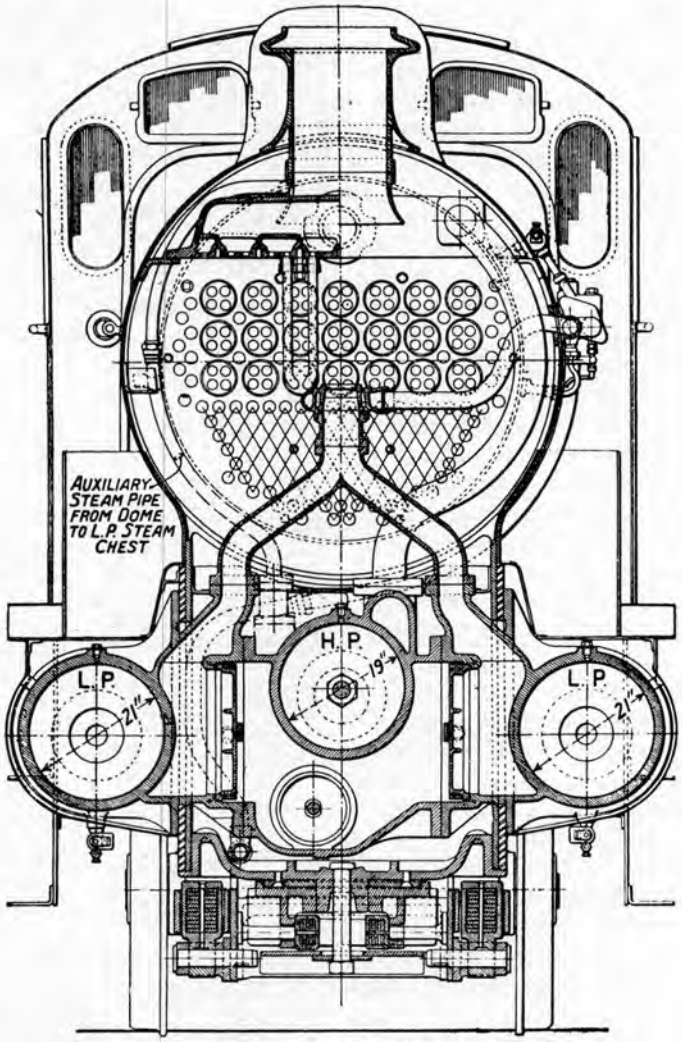
Compound No. 1152, standing outside Rugby

Engine No. 1039 at Trafford Park shed

the very successful performance of No. 1065, but the very free steaming of No. 1060 with the reduced diameter of blastpipe orifice proved too great a temptation to be ignored, and the test report ends with this recommendation:

'From the foregoing, as Engine No. 1065 gave the better all-round performance it is recommended that the cylinders of all Compound Engines are similarly linered (H.P. 19 in. and L.P. 21 in.) and further to ensure satisfactory steaming, a chimney petticoat should be fitted and the blast cap orifice made $4\frac{5}{8}$ in diameter.' Diamond in his reply to the discussion on his paper refers to this:

'The only recent alteration to the blast-nozzle of these engines had been the *temporary reduction* of its diameter. This might seem strange, but the prime necessity of a locomotive was that it should steam freely, and this was a regrettably easy way of achieveing that result. It was a method that produced so serious an effect on the coal consumption that one marvelled that the alternative of using less steam by a more efficient distribution had had so slender an appeal to the locomotive engineers of the past.'



Cross-section of standard L.M.S. Compound

CHAPTER 7

THE PRESTON-CARLISLE TRIALS OF 1925: LARGER COMPOUNDS : OIL FIRING

The test results obtained successively with engines 1008, 1065 and 1066 over the Settle & Carlisle line had justifiably put Derby 'on top of the world' so far as engine performance on the L.M.S.R. was concerned, and with the North Western people disappointed and dispirited it was the Midland that was definitely stealing the honours in a way that its most fervent admirers would scarcely have believed two years earlier. One wonders indeed if the astonishingly successful performance of the superheated compounds between Leeds and Carlisle had not taken Derby itself by surprise. But in any case the prowess of the compounds fitted in so completely with the Midland idea of train operating, as envisaged for the entire L.M.S.R. system, that it was eventually to place these in a rôle for which the Chief Mechanical Engineer was not prepared to back them. From being most carefully nurtured 'pets', they seemed likely to become the strenuously used maids-of-all-work for the whole line.

The prelude to their general introduction on the North Western main line, and their simultaneous invasion of Scotland, was a little publicised but very important series of dynamometer car trials between Preston and Carlisle, held in May 1925. There are two reasons why this event almost completely escaped attention in the railway press of the day: first, that the tests were carried out on special trains of empty stock, and were run at times when travellers by ordinary Anglo-Scottish expresses were unlikely to see the 'specials'; secondly, the tests took place in the fortnight immediately following the great interchange trials between the

Glasgow—St. Pancras express, passing Port Carlisle Junction: engine No. 1067

St. Pancras—Glasgow express passing Port Carlisle Junction: engine No. 1068

L.N.E.R. Pacifics and the Great Western 'Castles'. The latter event had attracted the attention of vast numbers of railway enthusiasts, many of whom spent days of their annual leave travelling behind the rival engines.

It is thus not altogether surprising after the attention that had been given to the contest of giants farther south that this purely domestic affair in the Westmorland hills, of which no advance information had leaked out, remained almost completely unknown. I have seen, many years afterwards, some oblique references to the results, which rather indicate that this particular set of trials was being confused with a series that took place in 1922 between Crewe and Carlisle, when Lancashire & Yorkshire and London & North Western engines were involved.

In May 1925 four locomotives were tested: a Lancashire & Yorkshire Hughes rebuilt 4—6—0, known as Class 8; London & North Western 4—6—0s of both 'Prince of Wales' and 'Claughton' classes, and a Midland compound. In 1926 a Caledonian Pickersgill 4—6—0 of the '60' class was put through the same set of tests in identical conditions of loading. So far as the rivals of the compounds was concerned there was no mistake about the North Western engines this time, and a 'Claughton' in excellent 'nick' was put on to the job. The choice of a compound fell once again upon No. 1065, which by that time had amassed a mileage of 28,063 since new out of Derby. At the time of the Preston —Carlisle trials of May 1925 she had run a little over 10,000 miles since her cylinders had been lined up to 19 in. and 21 in. diameter. The two Class 4 engines—the 'Prince of Wales' and the compound—ran two return trips from Carlisle to Preston and back with 300 and 350-ton trains; the two Class 5 engines ran similar tests with 350 and 400-ton trains. As on the Settle and Carlisle line the 'specials' were timed to the same schedules as the fastest ordinary expresses of that period over the route, namely, 114 min. for the 90 miles southbound, and 103 min. for the northbound trip.

The enginemen chosen for this job all belonged to Carlisle. The compound was worked by Durran Hill men, who had learned the road to Preston previously to the tests; but according to the report engine No. 1065 had never been over the route before. This, of course, was of no consequence providing that her driver knew the road sufficiently well to run with confidence. The conditions laid down were that each engine should take its load without assistance, and that every effort should be made to conform to the working times allowed throughout the run, especially between Carlisle and Shap Summit on the outward trip, and between Preston and Shap Summit on the return. There is no doubt, however, that the four engine crews concerned entered into the spirit of things in such a way as to make something of a sporting contest of

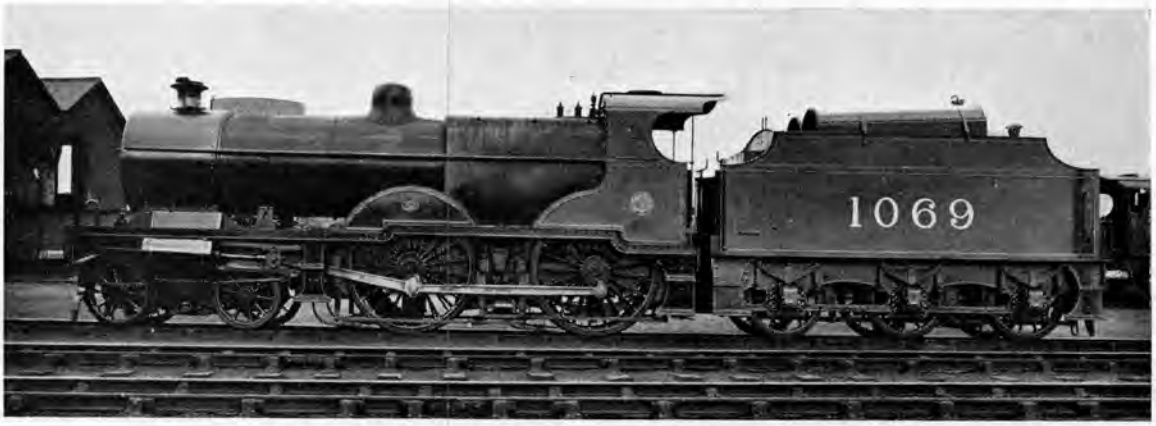
it. The North Western man on the Horwich 4—6—0 did some very spectacular hill-climbing on certain trips, rather confusing the issue by getting well ahead of time, though he paid the penalty, in overtaxing the capacity either of his boiler or his fireman—or both, and in heavy coal consumption. The compound, No. 1065, ran true to the magnificent form one had come to expect from this engine, though in the tests with 350-ton trains her actual coal consumption in pounds per mile exceeded that of the North Western 'Claughton'. This was indeed a reversal of events from November 1924, but the latter engine, No. 30, *Thalaba,* was clearly driven and fired with great skill and enthusiasm.

When it came to comparing the coal consumption in relation to actual work done, in the coal burnt per drawbar horsepower hour, the compound once again came out on top, as follows:

	Coal per D.H.P. hr.
300-ton trains:	
"Prince of Wales 4–6–0 .	5.1
Compound No. 1065 .	4.29
350-ton trains:	
"Prince of Wales 4–6–0 .	5.05
Compound No. 1065 .	4.25
Horwich 4–6–0 . .	5.07
"Claughton" 4–6–0 .	4.78

The figures recorded thus with No. 1065 between Carlisle and Preston agreed very closely with those obtained on the Settle & Carlisle road in February 1925, in the comparative steaming trials against compound No. 1060. Over Shap No. 1065 not only did well so far as coal consumption was concerned. She was certainly worked hard, but she took the banks in grand style, and on the down journey of May 8, 1925, when she was hauling a 350-ton load, the ascent of Grayrigg bank ranks as one of the finest pieces of Midland compound performance I have ever seen. She was heavily checked at Lancaster, for permanent way repairs, and speed was reduced to 10 m.p.h.; but the recovery was rapid, and the 6.3 miles on to Carnforth took no more than 6 min. 14 sec., and speed had been worked up to nearly 70 m.p.h. by the time the ascent to Shap was commenced.

Although there are two short stretches of favourable gradient intermediately, the plain fact remains that the line rises 885 ft. in 31¼ miles. The average gradient is thus 1 in 187. The climb is considerably easier in inclination than the famous 'long drag' of the Midland, between Settle Junction and Blea Moor, but more than twice as long. Schedule time for the tests was 42 min., requiring a pass-to-pass average speed of 44.8 m.p.h. At the beginning of the climb No. 1065 was working 70 per cent. in the high-pressure cylinder and 60 per cent. in the low.



An official photograph of No. 1069 equipped for oil burning in 1926

The regulator had been eased back to a position about two-fifths over on the quadrant. The water level was up to the top of the glass, and boiler pressure was 192 lb. per sq. in. The performance on the climb to Shap can best be appreciated from a tabular summary of times, speeds and details of the engine working. Thus against the scheduled average speed of 44.8 m.p.h. No. 1065 made an actual average of 50.3 m.p.h., and although the engine was being worked extremely hard boiler pressure was being steadily maintained and water level kept constant. This effort thus represented the sustained capacity of the engine, and not any transitory burst of energy obtained by mortgaging the boiler.

Comparisons may be odious, but it was nevertheless by comparisons with other L.M.S.R. locomotives that the fame of the compounds was

established. In years just before World War I the London & North Western superheated 4—4—0s of the 'George the Fifth' class were doing wonderful work with the Anglo-Scottish expresses over Shap, taking very heavy loads without assistance. Their work was sometimes compared, on very favourable terms, to what was being done at the same time by Midland engines over Aisgill. At that time the honours were undoubtedly with the North Western, while the superheated '999' class was only just getting into its stride. But against the magnificent performance of No. 1065—admittedly a 'star' engine, being worked hard under the stimulus of competition—the very best time I can turn up with a 'George the Fifth' is one of 39 min. 44 sec. from Carnforth to Shap Summit, with a load of 370 tons. A summary of the best times of six runs, with loads from 340 tons gross to 390, shows 13 min. 5 sec. to Oxenholme, 24 min. 5 sec. to Grayrigg, 29 min. 49 sec. to Tebay, and 38 min. 35 sec. to Shap Summit.

It was, outstandingly, in the ascent of Grayrigg bank that No. 1065 scored such a triumph. Her time of 9 min. 47 sec. from Oxenholme to Grayrigg, with its average speed of 43½ m.p.h., showed an advantage of 1 min. 13 sec. over the best L.N.W.R. 4—4—0 time. The maximum drawbar horsepower recorded with the compound occurred about 2½ miles north of Tebay, on the 1 in 75 of Shap. This was 935, at a speed of 49 m.p.h. Correcting this value for gradient gives the remarkable equivalent d.h.p. for a 4—4—0 locomotive of 1330. At that moment the driver was evidently making every bit of use of the impetus he had on passing Tebay at high speed, and in the next three miles of 1 in 75, up to Shap Summit, speed fell to 25.5 m.p.h. But it was a noble effort.

Technical details of the performance on this remarkable run over the entire run from Preston to Carlisle were:

Average drawbar pull	2.26 tons
Maximum drawbar pull	4.75 tons
Average drawbar horsepower	702
Coal consumption	
,, Pounds per mile	43.4
,, Pounds per d.h.p. hour	4.25
,, Firing rate (average)	2240 lb. per hr.
,, per sq. ft. of grate area per hour	78.9
Water, pounds per hour	16,000lb.
,, pounds per lb. of coal	6.83
Average speed, start to stop	54 m.p.h.

I need hardly add that the engine had done equally well on the southbound trips, and although all the engines engaged in these tests had kept their running times comfortably No. 1065 was by some margin the smallest of the engines engaged. In the year 1925 a 4—4—0 engine that could take a 350-ton train from Preston to Carlisle, over Shap, at an average speed of 54 m.p.h., on a coal consumption of no more than 43.6 per mile, was something very much out of the ordinary, and the large-scale multiplication of the class for general service on the L.M.S.R. was amply justified. Within a year one hundred more compounds had been added to the stock, as follows:

Engine Nos.	Built
1085—1114	Derby Works
1115—1134	Horwich Works
1135—1159	N.B. Loco Co.
1160—1184	Vulcan Foundry

By the time the last of these engines were on the road, in the spring of 1926, the allocation of the whole class, now 185 strong, was:

Engine Nos.	Allocation
1000—1050	Midland
1051—1056	L.N.W.
1057—1064	Midland
1065—1069	Scottish
1070—1075	Midland
1076—1084	L.N.W.
1085—1109	Midland
1110—1134	L.N.W.
1135—1149	Scottish
1150—1184	L.N.W.

One of the Kingmoor compounds going south: No. 1141 piloting a Stanier 'Jubilee', on a Midland express for St. Pancras leaving Carlisle

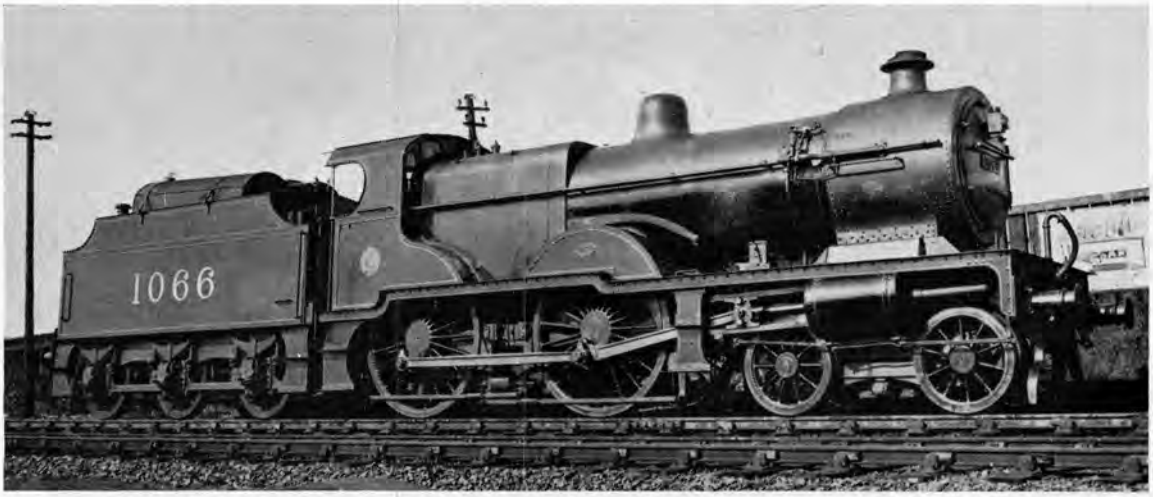
One of the superheated Deeley compounds No. 1038, equipped for oil burning

The totals were thus: 90 to the Midland; 75 to the North Western; and 20 to the Scottish division, all of which latter engines were stationed at Kingmoor. The Midland quota was doubled, as compared with that of the pre-grouping times, thus indicating the extent to which the Midland Railway had been starved of powerful engines in its independent days.

Before proceeding to the story of compound prowess on the L.M.S.R. following this great extension of their sphere of activity, it is of interest to summarise the results of the various tests that had been carried out with these engines since grouping. To the runs on the Settle & Carlisle line, and those between Preston and Carlisle, must be added those which took place in January and February 1927. At that time a sustained attempt was being made by the Derby authorities to improve the everyday performance of the 'Claughtons', which, in common with most North Western locomotives at that time, was just about at its lowest ebb. Engine No. 5923, *Sir Guy Calthrop,* had certain alterations made to the air spaces through the grate, and had been re-tubed, and a series of dynamometer car tests were made with this engine between Crewe and Carlisle.

To get comparative results, a Midland compound, No. 1073, and a standard 'Claughton' were brought into the series of tests. The runs were made on the Glasgow portion of the 10 a.m. from Euston, with tare loads of about 300 tons. At that time the 141.1 miles from Crewe to Carlisle were scheduled to be covered in 163 min., and on these trials compound No. 1073 gave considerably better results than No. 1065 and 1066 had done in the trials of 1924-5. Engine No. 1073 made no more than a single return trip, going north on February 3, 1927, and returning the following day.

Going north the tare load was no more than 281 tons, though returning on the following day the load was 315 tons. The coal consumption on the round trip worked out at no more than 34 lb. per mile and 3.78 lb. per d.h.p. hour. By comparison with the final tests of 1925 the task set to the compound was very easy; and why, on the northbound runs, she was given one coach less than the 'Claughtons' is something of a mystery in view of the performances that had been recorded with engines 1065 and 1066 in 1924-5. Nevertheless the summary details of these tests, which were given by Sir Henry Fowler himself, at a meeting of the



No. 1066, one of the celebrated engines of the 1925 trials equipped for oil burning

Institution of Mechanical Engineers in December 1927, provide another piece of data by which the Midland compounds may be assessed. In the vital matter of fuel consumption in relation to work done —coal, in lb. per drawbar horsepower hour—the following results had been obtained.

Engine No.	Route	tons tare	Coal per D.H.P. hour lb.
1008	Leeds and Carlisle .	220	4.22
1008	,, ,, ,, .	230	4.5
1008	,, ,, ,, .	250	3.94
1008	,, ,, ,, .	300	3.80
1008	,, ,, ,, .	300	4.02
1008	,, ,, ,, .	350	3.78
1008	,, ,, ,, .	350	4.2
1008	,, ,, ,, .	350	3.71
1008	,, ,, ,, .	350	3.8
1023	,, ,, ,, .	350	4 45*
1023	,, ,, ,, .	350	4.42*
1065†	,, ,, ,, .	300	4 46
1065†	,, ,, ,, .	300	4 39
1065†	,, ,, ,, .	350	4 33
1065†	,, ,, ,, .	350	4 45
1066†	,, ,, ,, .	300	4 68
1066†	,, ,, ,, .	350	4 43
1060	,, ,, ,, .	300	4.72
1060	,, ,, ,, .	300	4 65
1060	,, ,, ,, .	350	4.77
1065§	,, ,, ,, .	300	4.22
1065§	,, ,, ,, .	300	4 18
1065§	,, ,, ,, .	350	4 15
1065§	Preston and Carlisle .	300	4 29
1065§	,, ,, ,, .	350	4 25
1073	Crewe to Carlisle .	281	3.78
1073	Carlisle to Crewe .	315	

†Engine with 19¾in. H.P. and 31¾in. L.P. cylinders.
§Engine with 19 in. H.P. and 21 in. L.P. cylinders.
*Engine lost time on test schedules laid down.

From the foregoing table it can be judged that the compound engines in good condition and worked on top link duties by top link crews would do their work on a basic coal consumption of around 4 lb. per d.h.p. hour. On some trips where the conditions were particularly favourable one might get figures of less than 4; but even No. 1008, which appeared to be an outstanding engine in every way, made some trips with lighter loads, when her basic consumption rose to as high as 4.5 lb. per d.h.p. hour.

Apart from the actual fuel consumption, important though it was in economic conditions that were steadily worsening by the year 1926, the compounds in these various trials, and in their general performance on the road, had shown that they were the equals of their principal rivals as general service passenger engines, the London & North Western 'Prince of Wales' class, in haulage capacity, and their superiors in economy. So far as the larger L.M.S.R. engines were concerned, while the trials between Leeds and Carlisle in 1924 and the poor performance put up by the 'Claughton' must have brought an inward joy to Derby, the trials between Preston and Carlisle in May 1925, which showed the 'Claughton' class in its true light, made it clear that Crewe had in them an engine of considerably greater potential capacity than a compound, and moreover one that was not so inordinately heavy on coal as the more vehement partisans of Derby would have made us believe. Nevertheless, the general performance of the 'Claughtons' at that time, up and down the West Coast main line, was very far from satisfactory. This is no place to discuss the reasons for a rather sorry state of affairs,

but there was certainly no case for the perpetuation of this Crewe design of 1913, when larger engines were needed.

After Sir Henry Fowler had succeeded Hughes as Chief Mechanical Engineer of the L.M.S.R. in 1925, headquarters of the department was moved from Horwich to Derby, and the staff there found themselves in the position of having to consider the provision of new locomotives for a positive 'empire' of railways. Thoughts had already been turning to larger compounds, although the operating authorities had not openly expressed any desire for larger engines. The filing cabinets in locomotive drawing offices in many parts of the world contain proposals for many fascinating 'might-have-beens', and of these, a most interesting example is that of the enlarged Midland compound of 1925. A line drawing has been prepared from the Derby diagram, and from this drawing Mr. Jack Hill has prepared a brilliant artist's impression of what this notable engine would have looked like.

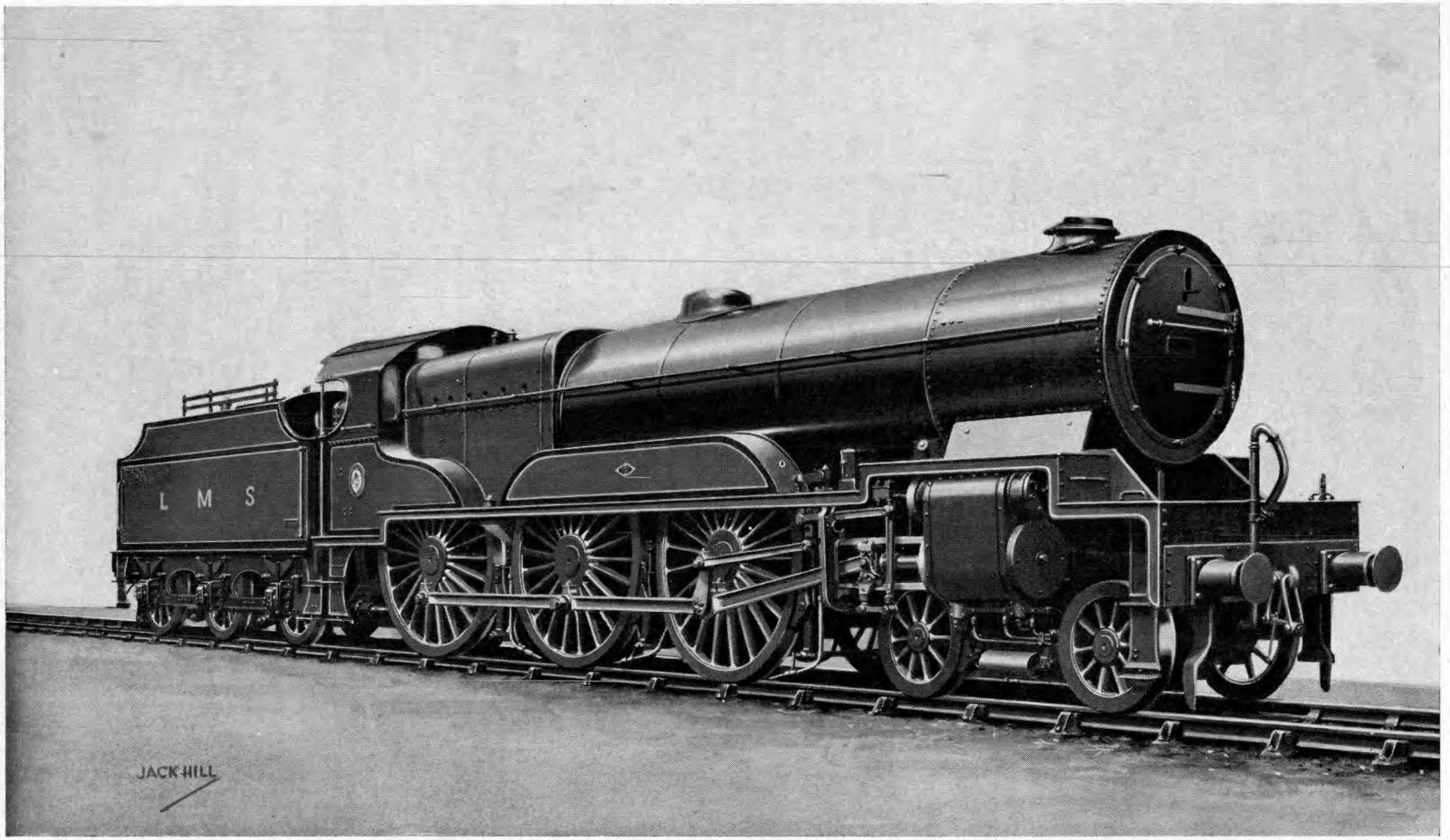
Except in its use of outside Walschaerts gear, and piston valves mounted immediately above the cylinders, it was literally an enlargement of the standard compound 4—4—0. All superficial details were the same: the cab, the sweep of the splashers over the rear coupled wheels, and the firebox all followed faithfully in the Derby tradition. The cylinders were to have been 20¾ in. diameter high pressure, and 22¾ in. low pressure, with a stroke of no less than 30 in. in each case, and the 'enlargement' of the 4—4—0 compound was carried to the extent of driving on to the leading pair of coupled wheels, and having a long wheelbase of 8 ft. 3 in. between the rear bogie and the leading pair of coupled wheels exactly the same as on the 4—4—0s. The boiler barrel would have been about the same size as that of a North Eastern three-cylinder Atlantic of Class 'Z', but slightly smaller in diameter. It was considerably longer than the big 4—6—0s of later years that were actually built. The length was 16 ft. 6 in., as compared with 14 ft. on the 'Royal Scots', and 13 ft. 9 in. on the 'Lord Nelsons'.

The proposed boiler pressure was 220 lb. per sq. in., thus not exceeding the maximum that had been used in standard Midland locomotives in the past.

The nominal tractive effort, at 85 per cent. boiler pressure, worked out at 32.270 lb., and the close correspondence of this with the 33,150 lb of the 'Royal Scots' inevitably makes one speculate as to how the two would have compared in actual performance. At the same time the design for the enlarged compound was worked out, Derby was still using short-lap, short-travel valves, and although a change to Walschaerts gear was proposed this was probably no more than a desire to get two out of the three sets outside, and more accessible. But quite apart from any predictions about performance the 4—6—0 compound would have been a far finer looking engine than the 'Scot', and not so heavy, despite the increased length. This reduction in weight was no doubt due to the use of no more than 220 lb. pressure, against 250 lb. on the 'Scot'. When the latter engines were equipped with the big Stanier tenders, carrying 9 tons of coal, and 4,000 gallons of water, the total wheelbase of engine and tender became 54 ft. 9in., against 54 ft. 8¾ in. on the Fowler three-cylinder compound 4—6—0.

There had been a time on the Midland Railway when Fowler had seemed more inclined to develop the superheated simple 4—4—0s, than to carry the development of the Deeley compound any farther. The latter engines, as he stated publicly on several occasions, had given every satisfaction, but one senses that he would liked to have been rid of the complication of compounding. The numerous tests carried out since grouping had, however, shown, most convincingly, the extent of compound superiority over all comers, and it was no more than natural that he would turn towards compounds when the need came to produce new and larger engines for the L.M.S.R. Then, early in 1926, came that paper by E. L. Diamond, read before the Graduates' Section of the Institution of Mechanical Engineers, to which I have referred in the previous

One of the most 'tested' of Midland compounds No. 1065, as B.R. No. 41065 leaving Morecambe with the 2.45 p.m. Leeds express in 1954



Sir Henry Fowler's proposed 3-cylinder compound 4-6-0 which was never built. This vivid impression, by Jack Hill, has been prepared from the official drawing

chapter. A most distinguished contributor to the discussion was Monsieur A. Bréville, Chief Mechanical Engineer of the Northern Railway of France. He gave some extremely interesting details of the results obtained with his new 'Super-Pacifics', on the de Glehn principle, which were then doing some quite outstanding work on the boat trains between Calais and Paris, and it is probable that this data encouraged Sir Henry Fowler to push rapidly ahead with a cherished project for a still bigger compound engine.

This great locomotive, which was to have been a Pacific, really lies outside the present story, because the arrangement of its machinery was to have been on the lines of a de Glehn, rather than a Smith-Johnson compound. The high-pressure cylinders were to have been outside, and the large low-pressure pair, $23\frac{5}{8}$ in. diameter, inside. Furthermore the stroke, which it was proposed to make 30 in. on the 4—6—0 'Midland' compound, was again cut back to 26 in. The outline drawing indicates a massive and impressive engine, but one less endowed with the grace and character of the traditional Derby style than the proposed three-cylinder compound 4—6—0. One mentions the projected four-cylinder compound 'Pacific' to show the extent to which Sir Henry Fowler was adhering to the compound principle. It was carried, in that same year of 1926, to the extent of designing a huge 2—8—2 four-cylinder compound freight engine using the same cylinders and front-end as in the projected Pacific, save that the 2—8—2 was to have had 5 ft. 3 in. wheels. This seemed quite clearly a counterblast to Gresley's 'P1' class 2—8—2s, Nos. 2392 and 2394, then engaged in heavy mineral service between Peterborough and Hornsey Yard.

All this compound designing activity at Derby was obviously inspired by the great success of the Midland 4—4—0s and of their L.M.S.R. derivatives in the various trials that had taken place since 1923, and it rather gives the impression that Sir Henry Fowler, whatever his very great qualities in other directions, had no very strong ideas of his own where locomotive design was concerned. In 1927 he was President of the Institution of Mechanical Engineers, and having so recently succeeded to the great office of Chief Mechanical Engineer of the L.M.S.R. one would have thought he would have dwelt at some length upon the problems and achievements of his department. Instead he gave a most learned discourse on metallurgical matters. In contrast to his distinguished contemporaries on the other leading British railways, while Collett was essentially a 'Works' man, and Gresley's heart was on the footplate, Fowler's delight was in 'the back room', in the laboratory, and in the problems associated with it.

In the meantime the year 1926 was proving one of the most difficult in history for the railways of this country. The General Strike, in May, was followed by the continuation of the coal stoppage, right through the summer months. And while the coal industry committed economic suicide the railways had to carry on with imported fuel, as best they could. On the L.M.S.R. a number of locomotives were equipped to burn oil fuel, including some of the compounds, but there were so few in number against the motive power stud as a whole as to constitute no more than a gesture. They can have contributed little towards the easing of the desperate need for decent coal that was felt all over the line, and on the railways of this country generally. Nevertheless, the apparatus concerned is of interest towards the full history of the Midland compounds. Those that were so equipped did work that was generally indistinguishable from the ordinary day-to-day running of the coal-fired engines on the Midland line. Whether they would have been able to rise to the heights of achievement attained by engines 1008, 1065 and 1066 in the trials of 1923-5 is another matter.

On the oil-fired engines the fuel was stored in two cylindrical tanks mounted on the tender, with their longitudinal axes sloping downwards towards the footplate; these were filled from the top from an overhead pipe through a gauze filter. The oil passed from the bottom end of the tanks by gravity to a main valve on the tender front, which valve was secured by a padlock and key when the engine was on shed. From this main valve the oil travelled underneath the footplate boards and fall-plate through a flexible rubber hose, protected with metal bands, where it passed through the back angle-plate of the footplate, and thus to the regulating valve under the footplate. This valve was operated by a long spindle passing through the footplate boards, with a handle conveniently placed for the fireman. As in the more recent applications of oil-firing the handle had a pointer working round a graduated scale, designed to aid the fireman in making adjustments of the oil feed. But all too often the handle worked very stiffly, and resulted in 'adjustments' being made by hammering the handle with the largest and heaviest implement available. The result more often than not was incomplete combustion, and a trail of filthy black smoke.

From the regulating valve the oil passed through another flexible pipe to the burner, which was fixed to a plate that replaced the lower part of the firehole door. As the burner was well below the level of the

storage tanks on the tender the feed was entirely by gravity. A relatively light oil was used, which flowed fast enough naturally to meet all demands. The burner was a brass casting, with a detachable lip containing two passages which opened at the face in the shape of rectangular slits, one above the other. The lower of these two slits was very narrow, and through it a thin fan-shaped jet of steam, drawn through a copper pipe from the carriage-warming outlet of the combination clack-box, was projected into the firebox. The quantity of steam thus used could be controlled from the foot-plate. Through the upper slit of the burner passed the oil feed. It dropped on to the fan of the steam jet and was instantly atomised. It ignited about 18 in. from the burner and made a long and intensely hot fan-shaped flame. The ordinary firebars were not altered, but the grate was covered with a layer of broken firebrick, 3 or 4 in. thick. Air was drawn through the firebox by the blast in the usual way, and controlled by the dampers. The broken brick became white hot while the burners were in operation; but after the engine had been standing by for some time the layer of brick would cool off, and the heat of the firebed had to be re-kindled by throwing logs of wood into the firebox.

The most vital adjustment of all, in a very simple outfit, was to set the direction of the jet correctly. If it was aimed too high the brick arch would be ruined, if too low there was a danger of melting the firebars. The correct adjustment on engines thus adapted during the coal strike was made by individual setting while on the run. The blast lifted the flame considerably, and so the engineer making the setting had to crouch down on hands and knees, on a rocking and swaying engine, and stare into the furnace to see at what point the flame was striking the throat-plate. Then, when the adjustment was made, the setting had to be locked and the adjusting nuts sealed.

From this it will be well appreciated that the conversion from coal to oil firing was a relatively simple matter. The arrangement as a whole was not ideal, for while the front of the firebox got extremely hot, the back, even when the engine was steaming its hardest, was relatively cool. This, of course, led to differential expansion, and cases of leakage; but generally speaking the adaptation was well worth while. Though it eliminated the labour of firing, few of the men really seemed to like it. One driver expressed it to me tersely: 'It's too explosive!' So far as I can trace there were no

Compound No. 1187 in B.R. days piloting a Stanier 'Jubilee' on the 9.26 a.m. Perth—Manchester express near Lancaster in 1954

accidents with the system, other than occasional damage in the fireboxes. But men used to coal-firing never seemed to get accustomed to the process of starting up the oil burners; and it may well have been the mild explosion that took place when the oil ignited that prompted the remark made by the driver I have previously quoted.

Although the following should not be taken as a typical and representative example of Midland compound performance with oil firing, the details of a test carried out by Mr. R. C. Bond in June 1926 on engine No. 1059 are extremely interesting as showing some of the points met with in the temporarily converted engines. The train was the 10.54 a.m. from Derby to St. Pancras, then making intermediate stops at Leicester and Wellingborough. Mr. Bond has permitted me to quote the following extract from his report to Herbert Chambers, then Chief Locomotive Draughtsman at Derby.

'The engine did not steam very well on this trip. Between Derby and Leicester the pressure gradually fell from 200 to 140-150 lbs. per sq. in. From Leicester to Wellingboro' the pressure varied (according to the road) from 176 to 160 lbs. per s. in. and from Wellingboro' over Sharnbrook Bank the pressure was 200-180 lbs. Running from Sharnbrook down to Bedford the pressure dropped down to 140 lb., due to filling the boiler with both injectors, and from Bedford up to Luton and on to London the pressure was maintained at 130-140 lbs. with half a glass of water. Time was kept easily with the train in spite of a strong side wind and some rain. On arrival at London it was found that the front wall had leaned forward slightly from the plate and the brick arch was tending to sag in the middle. The tubes were cleaned with sand twice, once leaving Leicester and again passing Bedford. The burner was adjusted to give as much oil as possible without making heavy smoke.'

Load: Derby—Leicester 299 tons tare
Leicester—St. Pancras 311 tons tare

Section	Dist. miles	Sch. min.	Oil consumption galls	Galls. per mile	Ton-miles (gross)	Gall. per ton mile
Derby—Leicester	29.5	35	103	3.49	12655	0.008
Leicester—Wellingboro'	34	40	127	3.74	15030	0.0085
Wellingboro'—St. Pancras	65	72	337	5.18	28730	0.0117

In Perth shed

CHAPTER 8

L.M.S. ENGINE POWER IN THE MELTING POT

An official photograph of a standard L.H. drive compound in early L.M.S.R. days: No. 1112

For the great majority of British railwaymen the Grouping of 1923 had been a time of tremendous upheaval. It was inevitable that among the new groups the practice of one or more of the old companies would predominate over the rest. Inside the L.N.E.R., for example, locomotive men of the North Eastern deeply resented the ascendancy of Doncaster, and on the Southern, in the newly-formed *entente* between Ashford and Eastleigh, the practice of Brighton was virtually obliterated. But nowhere did inter-railway antagonism run so deeply or so bitterly as between the men of the former L.N.W.R. and those of the Midland. And it was around the workings of the compounds on the North Western main line that the furore came to be centred. After the retirement of George Hughes it was certain that Derby men and Derby ideas would come to the fore, and while there were some die-hards to whom anything Midland was like the proverbial 'red rag to a bull' the great majority would have accepted things with philosophy, if not relish, had it not been for the rather tactless way in which many of the 'take-over' operations were conducted.

For a time the locomotive department of the North Western was seething. The allocation of Midland compounds to L.N.W.R. sheds was taken as an insult, and many were the tales of poor running, and of engines considered totally incapable of doing the job. In retrospect it would seem to have been a most inopportune moment to have introduced alien motive power on to the West Coast Route, and particularly between Euston and Wolverhampton. On the two-hour Birmingham trains the 'George the Fifth' 4—4—0s were doing some of the finest work of their whole career, while on the Manchesters the 'Prince of Wales' and 'Claughton' class engines were completely master of the situation. Moreover, the mere name 'compound' had an unhappy ring in the ears of many a North Western driver. The top link men of the mid-nineteen-twenties had mostly been express passenger firemen in the last years of the great Webb experiment with compounding, and they would

have carried vivid memories of struggles with the 'Jubilees' and the 'Alfreds', and perhaps of those fantastic slipping exhibitions indulged in by the 'Greater Britains' and the 'John Hicks'.

Nevertheless, the new Authority demanded that compounds should be put on to the best trains, even though they had to be double-headed; and in 1925 and the early part of 1926 I travelled on the 11.50 a.m. down Liverpool and Manchester express, on which No. 1078 was train engine, and behind No. 1151 on the 1.30 p.m. down Scotsman. What the limit of load was for a compound I do not know, but at that time Derby had decreed that all 4—6—0s, of whatever class, and whether ex-L.N.W.R. or ex-L. & Y.R., should be double-headed if the load exceeded 360 tons tare. As I have notes on one compound run of that period unpiloted with 335 tons, and of another piloted with 381 tons, it would seem that the compound load was the same —to go to extremes—as that of the Horwich 4—6—0s, and the 'Claughtons'!

I must add that the double-headed runs that I had during that period, in which compounds were involved, were without exception fast and punctual. It was on the Birmingham and Wolverhampton trains that the compounds at first cut such a poor figure.

Then came the General Strike of May 1926, followed by the coal stoppage, and it was extraordinary how the compounds disappeared as if by magic. Double-heading was forbidden, and on the much attenuated service of the West Coate Route, with vast loads, the 'Claughtons' stepped back immediately into their rôles of a dozen years earlier. 'George the Fifth' 4—4—0s were to be seen hauling trains of nearly 500 tons unassisted—but never a Midland compound on such a job. I remember talking to a driver at Euston one day in those months of industrial stress; it was on the 1.30 p.m. Scotsman, and a passenger who had evidently become used to the new order on the L.M.S.R. expressed surprise that one engine should be taking so heavy a load. The driver answered him quite dispassionately: 'Yes, sir; we're going on our own. This is *not* a Midland engine, this is a Nor' West.' For the record I may add that it was a 'Claughton', No. 1429, *Colonel Lockwood,* with a load of about 490 tons.

But amid the turmoil and the resentment there were sober-minded spirits among the North Western enginemen who realised that within its range of capacity the Midland compounds were very fine engines, and although little work of first-class quality was published at the time, at any rate so far as the North Western was concerned, it was not so

Two standard left hand drive compounds ascending Camden bank, with a heavy L.N.W. section express

Compound No. 1160 in B.R. days, piloting a Stanier 'Jubilee' on the 10.45 a.m. Glasgow—Manchester express near Milnthorpe in 1955

The 1926 locomotive exchange: engine No. 1047 on the 1.15 p.m. Paddington—Bristol 2-hour express near Reading

long ago that I heard from Baron Gérard Vuillet, of Paris, of an excellent run he had logged in 1926. He has since sent me complete details, and by his kindness I am able to publish it herewith. The engine in question was No. 1080, built at Derby in 1924, and then shedded at Longsight.

L.M.S.R. WILMSLOW—EUSTON

Load: 11 cars, 331 tons tare, 360 tons full
Engine: 3-cyl. compound No. 1080.

Dist. Miles		Sch. min.	Actual m. s.	Average Speed m.p.h.
0.0	WILMSLOW .	0	0 00	—
4.7	Chelford . .		7 53	—
14.3	Sandbach . .	15	17 03	62.9
—			sigs.	
18.8	CREWE . .	21	22 55	
20.9	*Milepost* 156 .		26 35	34.4
22.9	,, 154 .		29 14	45.3
23.9	,, 153 .		30 30	47.4
24.9	,, 152 .		31 51	44.5
25.9	,, 151 .		33 16	42.4
26.9	,, 150 .		34 42	41.9
30.9	,, 146 .		39 37	48.7
43.3	STAFFORD .	49	51 25	63.0
			p.w.s.	
49.9	*Milepost* 127 (Colwich) .		60 09	
52.9	*Milepost* 124 (Rugeley) .	59	64 30	41.3
59.9	*Milepost* 117 .		71 31	59.9
67.9	,, 109 .		78 51	65 4
73.9	,, 103 .		85 14	56 4
79.8	NUNEATON .	87	91 20	58 0
84.9	*Milepost* 92 .		97 05	53.2
94.3	RUGBY . .	102	106 22	60.7
100.9	*Milepost* 76 .		114 21	49.5
—			sigs.	
109.9	,, 67 .		124 03	55.7
115.9	,, 61 .		130 08	59.2
123.9	,, 53 (Wolverton) .		137 35	64.5
—			sigs.	
130.9	*Milepost* 46 (Bletchley) .	138	145 25	58 9
137.9	*Milepost* 39 .		152 14	61.7
139.9	,, 37 .		154 14	60.0
141.9	,, 35 .		156 22	56 2
142.9	,, 34 .		157 29	53 8
143.9	,, 33 .		158 40	50.7
144.9	,, 32 .		159 51	50.7
145.2	Tring . .	154	160 14	—
155.9	*Milepost* 21 .		171 02	60 0
—			sigs.	
161.9	,, 15 .		177 20	57.1
164.9	,, 12 .		180 12	62 8
167.9	,, 9 .		182 41	72 5
169.9	,, 7 .		184 13	71 0
170.9	,, 6 .		185 01	75 0
171.9	,, 5 .		185 51	72.0
—			—	
176.9	EUSTON .	187	193 20	

Net time 183¾ min.

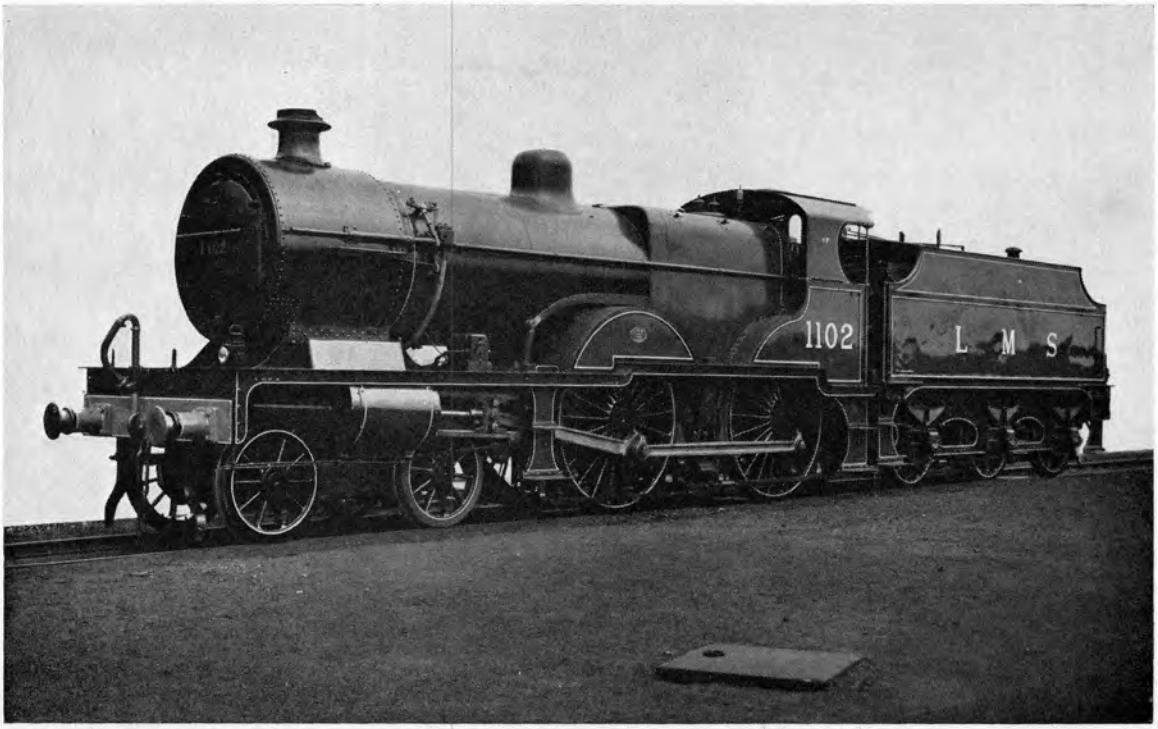
When the 3½-hour Manchester trains were put on again in 1923 the load of the 9.45 a.m. was normally about 250 tons, so that No. 1080 had a task considerably harder than usual. The schedule I have quoted was that of 1923, but I cannot be sure that the same booking was in force during the period of the coal strike. Baron Vuillet quotes no maximum and minimum speeds in the early stages, but his milepost timings indicate a minimum of about 42 m.p.h. on the 1 in 177 of Madeley bank. Then it was good work to run the 14 miles between Posts 46 and 32 in 14 min. 26 sec. after a signal check approaching Bletchley. The maximum speed of the journey was 78 m.p.h. between Wembley and Willesden Junction.

Before the days of the various dynamometer car trials this run, with its net average speed of 57.8 m.p.h. over a non-stop run of 177 miles, with a 360-ton load, would have been considered a marvellous achievement for a Midland compound. It was certainly a very good run, but nothing exceptional in the light of the proven ability of the class by that time.

In the meantime, during the early part of the year 1926 plans for the new 'super' compound locomotives were going rapidly ahead, too rapidly altogether for those who would eventually have to use the new engines. Nevertheless, the 'Midland compound' complex, beyond which the operating departments seemed quite unable to go, showed some signs of weakening after the experience of the coal strike period, when Midland traffic men had, for the first time in their lives, seen at first hand what the North Western 4—6—0s could do in the way of weight haulage. In addition to this a very strong 'anti-compound' front was established on the West Coast Route. After the experiences of Webb days it was a case of 'never again' with the majority of North Western running men. There grew up, indeed, a kind of unholy alliance between them and the 'old guard' of Midland operating men, who for some reason had a rooted objection to the 'Pacific' type as a locomotive for heavy express passenger duty.

The troubled summer of 1926 passed into autumn, and work was actually started on the new 'Pacifics' at Derby. The frames of the first new engine were cut, and all the time the controversy over the 4—4—0 three-cylinder compounds raged in the technical press. It was not only in *The Railway Magazine* that battle was joined. The correspondence columns of *The Engineer* and *Engineering* bore witness to the concern felt by many thoughtful observers that L.M.S. locomotive policy was on the wrong lines, though the issue

A standard L.H. drive compound on the L.N.W.R. section, No. 1115



A standard compound in the later L.M.S.R. style, with number on cab side. No. 1102

tended to become confused between the somewhat erratic performances of the Midland compounds on the North Western main lines and the fact that they were the *only* new locomotive to be introduced during the first four years of grouping. Their use, south of Crewe, turn and turn about, with the 'Prince of Wales' and 'Claughton' class engines suggested to the layman that they were considered their equals in all respects. It was, on the contrary, the relative easiness of current L.M.S.R. express train schedules that permitted all three classes to be allocated on a common-user basis.

The correspondence suggested, nevertheless, that on the North Western lines many of the drivers were not handling them properly, and were trying to work them as they would have done a 'George the Fifth' or a 'Prince of Wales'. At the same time some of the writers of critical letters were obviously unfamiliar with the working of the Midland compounds. On one occasion, when it was reported that an engine was doing badly after a good start, the writer suggested that the driver was bringing his regulator back too far, and that the point had been reached when the engine was working neither compound nor simple, but an inefficient mixture of both. This, of course, could not be done. Once the regulator had been opened fully the only way to stop full compound working is to close the regulator completely, and reopen on to the first valve. Instances were nevertheless quoted of Midland compounds being worked on first valve for the entire journey, turning them thereby into simple engines!

A correspondent who was considerably better informed than most, and who was, by his professional work, in fairly close touch with L.M.S.R. locomotive headquarters at Derby, wrote in *The Railway Magazine* of November 1926:

'It has never been the ultimate intention to replace either the 'Claughtons' or the Class 8 Horwich

A typical L.N.W. section duty: engine No. 1108 on up Birmingham express near Watford

4—6—0 engines with 4—4—0 Midland compounds. The position simply is that large numbers of 4—2—2 and 2—4—0 engines have been scrapped all over the system. New express engines had to be built, and sustained tests have proved that the compounds are *by far* the most economical passenger engines on the system, and that there is very little difference between their maximum efforts and those of the 4—6—0 "Claughtons" and the "Princes" when all three types are capably handled. Therefore there was every justification for building large numbers of standard compounds, *provided* that the problem of building a really adequate "big" engine was tackled at the same time. This is where the L.M.S. has failed. The compound programme has been wholly commendable, but these engines have been prejudiced because they have been tacitly regarded as the *whole* solution of the problem.'

During all this controversy the building of the Fowler 'Pacific' had become a fairly open secret; but in that same issue of *The Railway Magazine,* commenting upon the many and varied letters that were pouring in, Cecil J. Allen let slip a point that might well have prepared us all for the next round in the L.M.S.R. motive power battle. He wrote: 'I think the last writer has put his finger on the chief trouble. It is that such large numbers of new engines should have been constructed by the L.M.S. authorities, which can never be equal to the duties of that railway, when there is so crying a need for the provision of locomotives fully abreast, in tractive power, of the biggest engines of neighbouring lines; further, that all but four years should have elapsed, since grouping came into operation, without anything material being done in the direction of enhanced locomotive power. Certainly a "Pacific" locomotive design had been prepared in detail at Derby, and it was to be no mere enlargement of the existing Midland three-cylinder compound 4—4—0s. To begin with, it was to work at 250 lb. pressure—a hitherto unheard of figure in this country. It was to be of the largest dimensions that the loading gauge would permit, including the provision of 23 in. or 24 in. low-pressure cylinders, between the frames. And the best Continental compounding practice had been closely studied with a view to producing a locomotive which should in every way be an outstanding British design.

'But now, alas, it appears unlikely that the engine will materialise, and the probability is that recourse will be had to more "Claughtons" possibly, with larger boilers than those at present fitted. Those who are interested in the advancement of the science of locomotive design in this country cannot view the decision I have mentioned with anything but regret.'

Engine No. 1167 on up 2-hour Birmingham express at Castlethorpe troughs

In his very next article Allen gave the first news of the locomotive surprise of the century:

'I have just space, in conclusion, to mention the fact of an extremely interesting locomotive exchange which is in progress at the time of writing. The L.M.S. authorities have borrowed from the G.W.R. their newest "Castle"—*Launceston Castle,* illustrated on the previous page—which has been working important trains between Euston, Crewe and Carlisle. Loads have been made up, on the London —Crewe stage, to a maximum of just under 500 tons, which the G.W. engine has handled with ease, on current Western Division Schedules. In exchange Midland compound No. 1047 has gone over to the G.W.R. for working trains between Paddington and Bristol and Birmingham. In view of the disparity between the size of the engines it is not to be expected that the compound will succeed in undertaking any of the maximum G.W. express turns of duty, but the exchange of two of the most thermally efficient British locomotive types is in any event a locomotive happening of no mean importance.'

Technically the event was very important, but more astonishing were, firstly, the way it was brought about, and secondly the sequel. In fact the Operating Department had pulled off a major *coup d'etat,* at the expense of the Chief Mechanical Engineer, in persuading the management that Sir Henry Fowler's four-cylinder compound 'Pacific' was not what was wanted for the traffic, and in engineering the loan of a Great Western 'Castle'. For Sir Henry the circumstances could not have

been more humiliating: he was instructed to stop work on the 'Pacific'; then to carry out dynamometer car tests on the 'Castle'; and then to build an engine of 'Castle' capacity. The Operating people indeed went to the length of demanding that the new engines should have three cylinders, and not four. A man of different temperament to Sir Henry Fowler would have resigned forthwith. But as I have previously explained, his personal interests lay far more in the direction of metallurgy than locomotive design, and his staff were instructed to carry out the new requirements of the management. Some eighteen months later, from the Presidential Chair of the Institution of Mechanical Engineers, he referred to the 'change of front' in the L.M.S.R. locomotive department in quite objective terms.

The occasion was a paper by that distinguished American locomotive engineer, Lawford H. Fry, *Some Experimental Results from a Three-Cylinder Compound Locomotive*—in that case a Baldwin 4—10—2. Sir Henry Fowler was in the chair, and in opening the discussion he said that he had been connected with three-cylinder compound locomotives for over twenty years, and had been a strenuous advocate of the compounding principle because of the consistently good results obtained from these compound locomotives in service. When, therefore, twelve months ago he had to consider the question of providing a larger type of locomotive than was in existence at that time on the London, Midland & Scottish Railway, his mind naturally turned to the compound principle. Unfortunately he had to abandon the idea of constructing what would have been the first high-pressure compound locomotive in this country (the pressure hitherto used on compound locomotives being 220 and, when superheated, 200 lb. per sq. in.) and, taking all the conditions into consideration, it was decided to build a three-cylinder simple engine working at a steam pressure which at that time was not being employed in this country, namely, 250 lb. per sq. in.

A great deal of attention had been paid to the boiler proportions finally decided upon, passed on the results of their previous experience, and also in the light of the experience of others and the Author's very valuable work. Indicator diagrams had not yet been taken from the new 'Royal Scot' engines, but during the past week road tests had been carried out with a dynamometer car attached

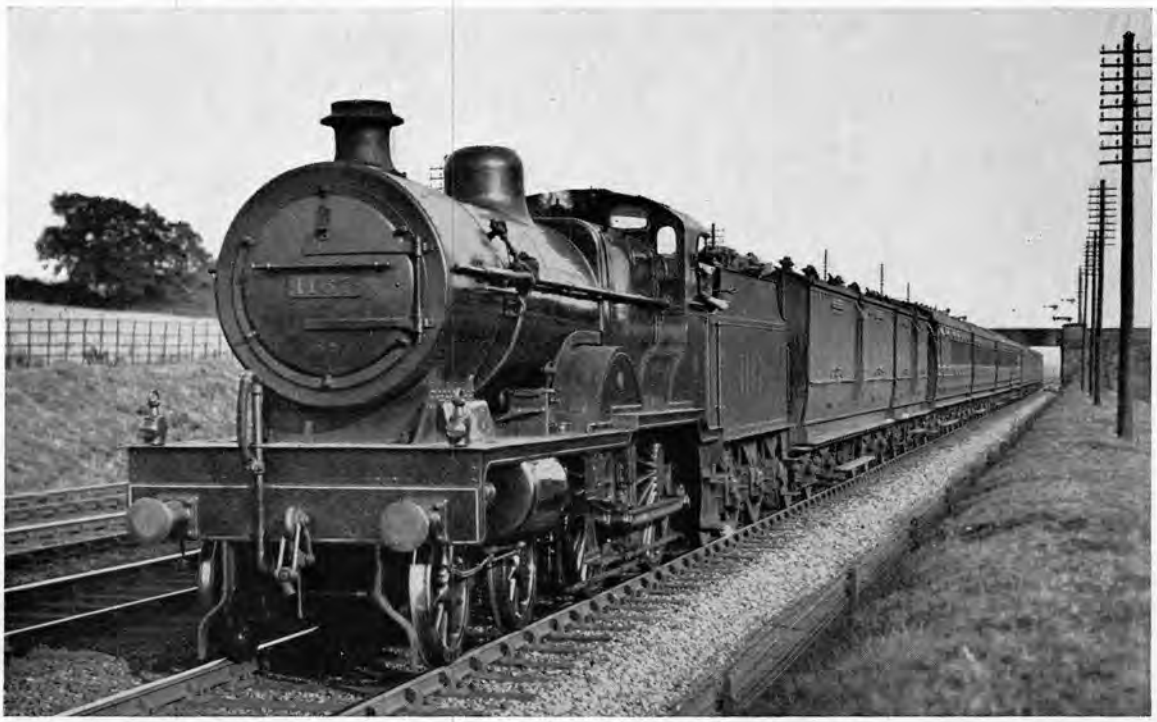
Engine No. 1165, on up 2-hour Birmingham express just on the south side of Watford Tunnel

to various express passenger trains worked by these locomotives, and the results were so striking and consistent that he thought it would be of interest to make known the figures to show what could be done with a single-expansion type of locomotive. Personally he thought that better coal consumption results might have been obtained with a compound, possibly working at a still higher pressure, but there were advantages in having a single-expansion engine, such as simplicity of mechanism. The engines were put on the road seven months after they were designed, and two months later were running on what, if not the fastest train, was at any rate the train with the longest non-stop run in the world. They had performed satisfactorily the work they had been asked to do.

In those terms Sir Henry Fowler himself told how the death-knell of compound locomotive development on the L.M.S.R. had been sounded. But the *Launceston Castle* episode provided some further diversity in the long, varied, and distinguished story of the Midland compounds. There was, of course, no question of an 'exchange' in the sense that the work of a 'Castle' and a Midland compound was directly compared. The L.M.S.R. sent an engine in exchange for the one they had borrowed for test purposes, and on the basis of the many tests carried out since grouping the Midland compound was unquestionably the most efficient design they had. For the month of the exchange No. 1047 was to be stationed at Bristol, and it was the intention for her to run to Paddington, to Birmingham, and to Plymouth on duties normally worked by the 4—6—0 'Saints' and the 4—4—0 'Counties'. It is perhaps significant that the actual engine chosen to represent the L.M.S.R. came from the Midland Division, rather than the North Western, and that she was worked by a Kentish Town driver throughout.

The programmes arranged were as follows:

1st week:	9.15 a.m.	Bristol to Paddington
	1.15 p.m.	Paddington to Bristol (2hr. train)
2nd week:	5.15 p.m.	Bristol to Paddington (2 hr. train)
	10.10 p.m.	West of England Postal: Paddington to Bristol
3rd week	2.20 p.m.	Bristol to Birmingham (via Stratford-on-Avon)
	6.35 p.m.	Birmingham to Bristol (via Stratford-on-Avon)
4th week:	8.45 a.m.	Bristol to Plymouth
	1.45 p.m.	Plymouth to Bristol.



Engine No. 1167 on down semi-fast train near Berkhamsted

The fourth week's running, however, did not take place. There was a shortage of engines at Kentish Town, and an S.O.S. was wired for 1047. There is no doubt that in the three weeks of experimental running she and her crew had created a very good impression. Conditions were difficult. In the late autumn of 1926 the railways of this country were still suffering from the effects of the coal strike. The Great Western in particular was having to use a great deal of imported fuel, and much of the stuff loaded on to the tender of 1047 was poor. Naturally most of the attention of railway enthusiasts was concentrated upon the work of *Launceston Castle* on the North Western main line, and very little detail of the running of the compound No. 1047 was noted. The only record of any consequence was on the 1.15 p.m. express from Paddington, as far as Bath, on a day when Cecil J. Allen was a passenger. The compound put up an excellent show, even though signal delays prevented a punctual arrival.

The accompanying log gives the running details of this journey. It was a good, though not exceptional, piece of work, with some pleasant going at 70 m.p.h. and over up the Thames Valley, west of Reading. The delay at Shrivenham, that stopped this important express dead for 2 min., put time-keeping to Bath out of the question. A Great Western driver might have gone harder on the downhill sections from Swindon, to try and recover more time, but this was the Kentish Town driver's

G.W.R. PADDINGTON—BATH

Load: 7 cars, 189 tons tare, 210 tons full
Engine: L.M.S. 3-cylinder compound No. 1047

Dist. Miles		Sch. min.	Actual m. s.	Speed m.p.h.
0.0	PADDINGTON	0	0 00	—
1.3	Westbourne Park		3 05	—
5.7	Ealing Broadway		8 35	58½
9.1	Southall	11	12 00	60/59
13.2	West Drayton		15 55	66
16.2	Langley		18 40	68
			p.w.s.	
18.5	SLOUGH	20	21 55	—
22.5	Taplow		26 15	61½
24.2	Maidenhead		28 00	64
31.0	Twyford	31½	34 05	68
36.0	READING	37	38 25	72½
41.5	Pangbourne		43 05	70½
48.5	Cholsey		49 00	72½
53.1	DIDCOT	53½	53 05	67
56.5	Steventon	57	56 10	65
60.4	Wantage Road		59 55	64½
63.9	Challow		63 10	64
66.5	Uffington		65 30	61
—			sigs.	
71.5	Shrivenham		72 00	
			74 00	
77.3	SWINDON	77	82 00	64
82.9	Wootton Bassett		87 15	69
87.7	Dauntsey		91 20	76½
94.0	CHIPPENHAM	93	96 40	66
98.3	Corsham		100 50	62½
101.9	Box		103 50	80½
104.6	Bathampton		106 10	
106.9	BATH	105	109 05*	

*arrival by slip coach Net time 100 min.

Engine No. 1169 on up 2-hour Birmingham express at Denbigh Hall, near Bletchley

first week over the road, and he did very well in the circumstances. Mr. Allen was travelling in the Bath slip coach, but it was reported that the main part of the train passed Bath in 108½ min. from Paddington, and with a very smart concluding run of 13¼ min. pass to stop, reached Bristol in 121¾ min. This gave a net time of 112¾ min., and an overall average speed of 63 m.p.h. throughout from Paddington. With a load of 210 tons to Bath, and one coach less over the final stage, this was not in any way an outstanding achievement. In fact, partisans of the North Western cause would probably state roundly that a 'George the Fifth' could have done just as well with 400 tons behind the tender! But as an example of Midland compound working on a foreign line it is well worth setting on permanent record. The run was probably made on a very low coal consumption.

By the end of the year 1925 no fewer than 185 compounds were at work on the L.M.S.R. with the numbers ranging from 1000 to 1184. So far nothing has been said about their work other than over the Midland and L.N.W.R. lines, but to bring the constructional side of the story up to date with that of the locomotive department politics, which cancelled the order for the compound Pacifics, and led eventually to the designing of the 'Royal Scots', it must be mentioned that a further 50 standard compound 4—4—0s were built in 1927. I believe it was intended at that time that there should be many more; because after completion of the series up to 1199, numbering started at 900, and significantly the ten Class 4 simple 4—4—0s of the '999' class were renumbered 800 to 809. This, it seemed, was to clear the way for compounds up to a grand total of 300. But after the batch of 50 in 1927, which took the numbers up to 934, no further engines of the class were built for five years, and then there came an odd batch of five, which was originally intended to be built at Crewe, but was transferred to Derby. Omitting this small batch, the story of compound construction was virtually complete by the summer of 1927, with the delivery of engine No. 934 from the Vulcan Foundry, and we can now look further afield to see the impact of the class upon L.M.S.R. trains running as a whole.

The last compound to remain in regular service, No. 1168, as B.R. No. 41168: withdrawn July 1961

CHAPTER 9

HIGH NOON OF THE COMPOUNDS: SCOTLAND: 1926-35

In coming to one of the phenomena of the Grouping Era on the railways of Great Britain one can indeed ponder upon what John Farquharson McIntosh and the men of St. Rollox would have said in 1913 if they had been told that a three-cylinder compound engine which had just been equipped with a superheater at Derby was the forerunner of what would be the standard express passenger engine for all purely Scottish services of the Caledonian and Glasgow & South Western Railways in 14 years' time. And it was to be not a development of the epoch-marking 1040 of the Midland Railway, but a watered-down version, with 200 lb. per sq. in. in pressure, instead of 220! One can imagine old 'J.F.M.' exclaiming, 'Och, come oot!'

Yet, so it was; and in Scotland the compounds swept aside the Glasgow & South Western and Caledonian engines by sheer merit. There were no sledgehammer tactics, to break down an old tradition, as had been used where the London & North Western was concerned. It is true that the first compounds to work in Scotland were all stationed across the border, at Kingmoor shed, Carlisle; but they were allocated to men of the Caley and of the Sou' West, and were accepted at once.

In the year 1925, when compounds first came to Kingmoor, there were not many Scottish engines that could hold a candle to them within the L.M.S. group. On the Caledonian there was *Cardean,* and her three remaining sisters; the two original McIntosh 6 ft. 6 in. 4—6—0s, Nos. 49 and 50; and those six splendid outside-cylindered 4—6—0s, Nos. 938 to 943, originally built for the Highland. But by the time of grouping Caledonian running policy had moved right away from the tradition of allocating individual engines to a very few selected duties, and the McIntosh express 4—6—0s worked turn and turn about with 4—4—0s on less auspicious duties than of old. And so far as the ex-Highland 'River' class was concerned, the Caledonian used them mainly on express goods trains between Perth and Carlisle. *Cardean* and her sisters, if tuned up to the form they were showing in 1910-4, would certainly have given the new compounds points and a beating so far as haulage capacity was concerned—if not in coal consumption; but so far as the rest of the Caley express passenger stud was concerned, the compound invasion of 1925 was a 'push-over'.

Moreover, when the first engines of the class came to Kingmoor there was no resistance, and no mechanical trouble. David L. Smith, writing in the *Journal* of the Stephenson Locomotive Society, said:

'In the parlance of the "new car", men seemed to "step in and drive away". One driver was a little apprehensive of how those "big wheels" might do on Beattock. When he found no difficulty he was prepared to go anywhere. Writers have commented that the Scottish drivers "took to" the compounds in surprisingly easy fashion. My own opinion is that this came about rather by chance. The compounds had a screw reverser. The Caley men knew nothing but the big lever and so-many notches "clear". They hadn't a clue where to set her, so they just wound up and cocked an ear outside till she was cracking like a Pickersgill and let her go. And as luck would have it, that was just about the best treatment for a compound. On the G. & S.W. the men were used to a horizontal scale; and they drew her up to about the 25 per cent. position, and although this was too far up for good working, they just fluffed along and burned hardly any coal, and with light trains and easy schedules everyone was happy. They say the G. & S.W. men at Kingmoor were running the Glasgow jobs on 25 lb. of coal per mile. No one seems to have had any difficulty in working the regulator and "changing over to compound". Except where a steep bank had to be

Engine No. 923 backing down to Perth General station, passing the ex-North British sheds

climbed from the start, stories of men on different sections working compounds for even shorter distances in "simple" are, in my opinion, quite untrue.'

By the time the compounds arrived at Kingmoor the old G. & S.W. shed at Currock Road had been closed, and the Sou' West engines accommodated with their one-time Caley rivals. But in 1925 the old traditions still persisted in another way, in that each driver still had his own engine. Again, in deference to past traditions, it was originally intended to allocate compounds with right-hand drive to the G. & S.W. men, who had always driven thus; but two of the compounds originally intended for Kingmoor were not available at the time of the first invasion, and so G. & S.W. men had to take two left-hand drive engines, 1138 and 1149, originally intended for the Caley section. The prowess of the Scottish compounds came earlier into the railway news than it might otherwise have done through a change in the locomotive working from that of earlier days. *Cardean* became one of the immortals of the locomotive world through her running of the up and down 'Corridors' every day for the best part of ten years; but in 1925 the down 'Corridor'—then 1.30 p.m. from Euston—was a Kingmoor job, not Polmadie, and the new compounds were naturally put on to it at once. So they very quickly came into the limelight of *British Locomotive Practice and Performance*. Moreover, they took that famous train out to Beattock unpiloted, a thing that had not been done on the Caledonian since *Cardean* came off the job.

It was, however, the building of the 900-924 batch, in 1927, that led to the distribution of compounds to many sheds inside Scotland, and led to the setting up of new workings that were full of interest for the locomotive enthusiast. We can pass over some of the strange first allocations of some of the new engines, which amply confirmed the feelings of many folks in Scotland that the reigning powers across the Border had little idea of Scottish motive power requirements. Perhaps the most asinine of these allocations was that of engines 910 and 911, which were sent to Fairlie Pier, above all places. Two express passenger locomotives could cover all requirements at that shed, and two of the

Whitelegg 'Baltic' tanks were already in possession. Two new compounds were thus entirely superfluous when Corkerhill, which was struggling with Anglo-Scottish expresses with nothing better than the rebuilt Manson 4—6—0s, still non-superheated, was in desperate need of new engines. One of the most useful of the 1927 allocations was to send two compounds to Aberdeen, whereupon through working was established, with lodging turns, between Aberdeen and Carlisle—the Ferryhill engines working turn and turn about with engines from Kingmoor.

At the end of 1933 the allocation of compounds in Scotland was:

Aberdeen	:	918, 938, 1134, 1183, 1184
Ayr	:	910, 915, 916, 1181, 1182
Balornock	:	1126, 1127, 1128, 1129
Carstairs	:	917, 1125
Corkerhill	:	911, 912, 913, 914, 1080, 1081, 1082, 1179, 1180
Dalry Road	:	919, 920
Kingmoor	:	1065, 1066, 1067, 1068, 1069, 1130, 1131, 1132, 1135—1149 inclusive, 1175, 1176, 1177, 1178
Perth	:	921, 922, 923, 924, 939, 1133
Polmadie	:	900—909 inclusive, 1083, 1084

At Polmadie shed, Glasgow: engine No. 1077 with high railed tender

One of the original Scottish compounds, in British Railways days at Derby No. 40910

There were thus 54 standard compounds stationed in Scotland, and of these ten, Nos. 1065-9 and 1080-4, had right-hand drive.

From among numerous published records I have picked out a number of runs which, between them, show the diversity of express passenger tasks undertaken by the compounds in Scotland, and which include one or two performances that are among the very finest ever put up by these engines. I do not think there was anything in ordinary service quite to equal the well-nigh incredible performances of engine No. 1008 in the Settle & Carlisle line trials of 1923-4; but there were many that came up to the best standards put up by engines 1065 and 1066 in the trials of 1924-5. The story is opened appropriately by a run on one of the earliest compound duties in Scotland, the down 'Corridor', then leaving Carlisle at 7.46 p.m. The journey tabulated herewith (1) was logged by Mr. Cecil J. Allen, and

TABLE I

7.46 p.m. CARLISLE—CARSTAIRS

Load: 48 axles, 330 tons tare, 345 tons full
Engine: 3-cylinder compound No. 1140

Dist. miles		Sch. min.	Actual m.	s.	Speeds m.p.h.
0.0	CARLISLE	0	0	00	—
4.1	Rockcliffe		6	45	—
6.1	Floriston		8	50	65
8.6	Gretna Jc.	11	11	15	—
13.0	Kirkpatrick		16	25	45
16.7	Kirtlebridge	21	20	55	60
20.1	Ecclefechan		24	35	—
22.7	*Castlemilk Box*		27	35	49
25.8	LOCKERBIE	30	30	35	65
28.7	Nethercleugh		33	15	68
31.7	Dinwoodie		36	05	—
34.5	Wamphray		38	45	68
39.7	BEATTOCK	45	45	05	
5.5	*Greskine Box*		11	30*	34
8.0	*Harthope Box*		15	55	32½
10.0	*Summit*	20	19	35	33
12.9	Elvanfoot		22	45	71½
15.6	Crawford		25	10	72½
18.1	Abington		27	20	66
23.5	Lamington		32	10	69
27.2	SYMINGTON	37	35	45	55½
28.8	Thankerton		37	15	71½
30.3	*Leggatfoot Box*		38	35	65
33.5	*Strawfrank Jc.*		41	25	72½
33.8	CARSTAIRS	45	42	25	—

*banked in rear, Beattock to Summit.

its immediate interest lies in the close adherence to a schedule time only a minute longer than that which obtained in the days of *Cardean,* at any rate as far as Beattock station was concerned. Of course, *Cardean* and the compounds were both in the No. 4

power class, but there was a considerable difference in the size and weight of the two engines. The normal load of the 'Corridor' in *Cardean's* day was about 305 tons, but this minimum rake of seven 12-wheelers was frequently strengthened, and loads of up to 420 tons have been taken unassisted up to Beattock.

The compound was worked hard out to Beattock, and her minimum speed of 49 m.p.h. up the second lengthy stretch of 1 in 200 ascent, from near Kirtlebridge to the summit just south of Castlemilk sidings, was excellent, with a load of 345 tons. Mr. Allen was justifiably enthusiastic about this earliest record of a compound on the 'Corridor' north of Carlisle; it must be added, however, that performance was at first not uniformly up to the same high standard, and one could sometimes note losses of one or two minutes between Carlisle and Beattock, with comparable loads. Although the men certainly did 'step in and drive away' they were nevertheless strange to the engines in general, and some variation in the quality of performance could occasionally have been expected. The type of engine used for banking from Beattock to summit does not appear in the original record. At one time some of the Pickersgill 4—6—2 tanks were employed on this duty, even in Caledonian days; but the more usual form of assistance was a McIntosh 0—4—4 tank, stationed at Beattock for the job.

Two Kingmoor compounds, Nos. 1140 and 1145 on the up Postal at Aberdeen. The leading engine is coaled to the maximum capacity of the tender for the 240-mile run to Carlisle

Downhill running on the Caledonian line went through several marked phases. The Drummond tradition, to secure the greatest economy in fuel, was to take things quietly uphill and run fast on the down grades; and this practice may be said to have reached its climax in the record run of the 4—4—0 engine No. 90 in the Race to the North in 1875. The 'Dunalastairs' were driven hard both uphill and down, and there was often some very fast running between Beattock Summit and Carstairs. The practice of smart downhill working persisted through the McIntosh regime, as witness the

The down 'Royal Scot' at Symington with engine No. 900 carrying the Caledonian semaphore headcode on the buffer beam

schedule of the 'Corridor' during the time of *Cardean's* lengthy innings, namely, 43 min. from Beattock to Strawfrank Junction, against the 45 min. booked when the compounds took over the job. In Pickersgill's time, which covered the first war period and its immediate aftermath, hard downhill running was definitely discouraged on the Caledonian. It has been suggested that it crept back again through the interworking of Crewe North and Polmadie men on the Anglo-Scottish expresses—the Scottish drivers taking their cue from their North Western counterparts. But as Table I shows, brisk downhill running began with the compounds long before the days of the Glasgow—Crewe double-home jobs. The compounds ran freely under a very light rein, and the Kingmoor drivers did not stay them in their courses.

The naming of the 10 a.m. Anglo-Scottish expresses 'The Royal Scot', and the special arrangement for the long non-stop workings began in the summer of 1927, before the Scottish section of the L.M.S.R. had any engines suitable for working it. The same strictures could also have been applied to the North Western at that particular time, though the task of the Euston—Carnforth non-stop run, at the moderate speed then scheduled, would certainly not have been beyond the capacity of a 'Claughton' on top form. The trouble, of course, was that very few of them were anywhere near top form at that time. From the Scottish end 'The Royal Scot' was worked between Glasgow and Carnforth by Midland compounds in pairs, and for this duty the new engines built by the North British Locomotive Company and allocated to Polmadie shed were used. It certainly revived memories of the Caledonian to have on the crack Anglo-Scottish expresses engines numbered 900 to 909; for if Nos. 908 and 909 had been mixed traffic units in Caley days, the rest had been top link express locomotives—900-902 being of the 'Dunalastair III' class, and 903-907 of course were the 'Cardeans'.

Down excursion climbing Beattock bank with engine No. 1146 (banked in rear)

Aberdeen—Euston express passing Symington hauled by engine No. 921

Table II herewith shows a run of the southbound 'Royal Scot', non-stop from Symington to Carnforth with a 16-coach train of 470 tons all told. The booked time to passing Carlisle was a minute less than that of the up afternoon Scotsman, on which the Pickersgill 4—4—0s often took loads of 350 tons or more. The two compounds thus had an easy task with 235 tons each, and some quite drastic easing down was necessary after Lockerbie to avoid passing Carlisle too far ahead of time. The point-to-point times from Carlisle to Penrith, in L.N.W.R. days, were always distinctly sharp and the two engines lost a little here. But there was an ample

TABLE II

SYMINGTON—CARNFORTH

"THE ROYAL SCOT"

Load: 64 axles, 445 tons tare, 470 tons full
Engines: Two Midland compounds, Nos. 905 and 903

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	SYMINGTON	0	0 00	—
3.7	Lamington		6 20	57½
9.1	Abington		12 30	50½
11.6	Crawford		15 35	49
14.3	Elvanfoot		18 50	54
17.2	*Summit*	23	22 40	38
21.7	*Greskine Box*		27 00	74 (max)
27.2	BEATTOCK	34	32 10	60
32.4	Wamphray		37 05	67
41.1	LOCKERBIE	48	46 00	eased
44.2	*Castlemilk Box*		49 35	47
50.2	Kirtlebridge	57	56 10	64/50
58.3	Gretna Jc.	66	64 25	66
62.8	Rockcliffe		69 00	49
66.9	CARLISLE	75	74 50	10 (slack)
71.8	Wreay		85 15	32
77.7	Calthwaite		94 00	41½
80.0	Plumpton	96	97 10	51
84.8	PENRITH	102	102 40	55½
88.0	*Eden Valley Jc.*		106 15	51
92.5	*Thrimby Grange*		113 45	34½
96.3	Shap		118 55	42½
98.3	*Shap Summit*	125	122 00	37½
103.8	Tebay	131	127 15	77½
109.8	Grayrigg		133 30	46½
116.9	OXENHOLME	145	140 05	75 (max)
120.5	*Hincaster Jc.*		143 15	66
122.6	Milnthorpe		145 00	69
125.3	Burton		147 40	55/65
129.7	CARNFORTH	159	152 50	

Compound No. 916 on down stopping train at Dumfries

Edinburgh portion of the up 'Mid-day Scot' arriving at Symington, hauled by No. 1142

Down express goods near Dumfries, hauled by engine No. 40920

Dumfries—Stranraer stopping train in B.R. days: engine No. 41099

Up 'Mid-day Scot' leaving Carstairs hauled by two compounds Nos. 907 and 1136

recovery margin on the heavier part of the ascent to Shap, and the summit was passed 3 min. early. Then the two Caledonian drivers allowed their engines to run swiftly down to Tebay, touching 77½ m.p.h., and they eventually handed over the train at Carnforth more than 6 min. early. It was not only on the 'Royal Scot' that pairs of compounds from Polmadie shed worked into England. The summer service of 1927 saw the introduction of non-stop running between Glasgow and Crewe on some of the night sleeping car trains, though none of their running seems to have been recorded in detail. The schedules were relatively slow, and the incentive was evidently not enough to induce any enthusiastic compilers of logs to make all-night journeys specially for the purpose.

In the recording of locomotive performance the experienced observer taking his notes from the train can, before the actual start, usually form some idea as to how a particular run may shape from noting the load, the type of engine, and perhaps also a knowledge of the link from which the driver and fireman come. The combination of a heavy load, with tight schedule, and a moderate-powered engine may arouse hopes that an exceptional effort might be made; but with steam locomotives it is not just a case of opening the regulator wide and blasting away; the skill of the fireman, the fuel, the mechanical condition of the engine can all influence performance. And perhaps there is that most vital factor of all, with steam, the personality of the driver. A first-class man will lead his fireman to outstanding efforts of skill and endurance, whereas a lesser character will lie down to adverse circumstances. Then, once in a way, the interested observer will find himself logging a performance of exceptional quality, in which the most optimistic expectations are excelled. Such an experience came to me one Saturday afternoon in the late summer of 1930, when I was travelling on the morning express from Leeds to Glasgow St. Enoch.

We had carried a load just in excess of 350 tons from Hellifield, and had been piloted up to Aisgill. But at Carlisle a portion for Edinburgh was to be detached, and I anticipated a manageable train of about 310 to 320 tons gross to be taken forward from Carlisle. At that time the working of the train was the same as in pre-grouping days, and the engines were changed at Carlisle. What I did not expect was such a crowd of passengers waiting to

go forward that two extra coaches were needed, and a tare load of 350 tons. To work us onwards to Glasgow was a Corkerhill compound, No. 913, in charge of that very fine G. & S.W.R. engineman, G. Paterson. Even though we were leaving Carlisle unassisted, I still expected that a pilot would be provided to help on the bank from Dumfries up to New Cumnock. What happened is shown by the log detailed in Table III. From the very outset it was evident that the driver and fireman were making an absolutely all-out attempt to keep time, despite this very heavy train of 375 tons. The run from Annan to Dumfries, including the short, though stiff, pull up to Ruthwell, was a classic in itself; but then, to my surprise and delight, no assistance was waiting for us at Dumfries.

The ascent to New Cumnock, where we kept almost exact time, was in the tradition of those magnificent trial runs over the Settle & Carlisle line in 1923-5, except that if anything it was even finer. Between Holywood and Milepost 60 we averaged 51 m.p.h. During this period, of 33½ min., the horsepower at the drawbar of the tender corrected for gradient was sustained at 950, with a maximum of 1109 on the 1 in 150 gradient leading to Drumlanrig tunnel. During the Leeds—Carlisle trials of 1923-4, engine No. 1008, by every standard of reckoning a most exceptional engine,

TABLE III

1 p.m. CARLISLE—ST. ENOCH

Load: 50 axles, 350 tons tare, 375 tons gross
Engine: 3-cylinder compound No. 913

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	CARLISLE .	0	0 00	—
4.1	Rockcliffe . .		7 00	51½
6.1	Floriston . .		9 10	62
8.6	Gretna Junc. .	11	11 40	50
9.6	Gretna Green .		12 55	48½
14.6	Eastriggs . .		18 15	66
17.5	ANNAN . .	21	21 30	
3.5	Cummertrees .		5 40	57½
7.1	Ruthwell . .		9 30	51½
11.7	Racks . .		14 10	66
15.6	DUMFRIES .	20	19 00	
3.4	Holywood .		6 00	50/54½
7.6	Auldgirth . .		10 47	48½
11.4	Closeburn .		15 25	52½
14.2	Thornhill . .	17	18 50	45
17.5	Carronbridge .		23 25	43¼
21.2	*Ardoch* . .		27 50	61½
26.1	SANQUHAR .	32	33 10	49
29.4	Kirkconnel .		36 55	56
31.8	*Milepost* 60 .		39 38	50¾
36.9	NEW CUMNOCK	45	45 10	60/58½
42.2	Old Cumnock .		50 30	67
44.2	Auchinleck .		52 30	60
—			p.w.s.	53
48.6	MAUCHLINE .	57	56 55	62
51.3	*Garrochburn* .		59 40	57/65
—			sigs.	
56.2	Hurlford . .		65 40	
—			p.w.s.	
58.0	KILMARNOCK	69	70 30	
2.2	Kilmaurs . .		5 05	36½
3.7	*Milepost* 20 .		7 40	31
5.5	Stewarton .		10 40	37½
6.7	*Milepost* 17 .		13 13	26
10.0	Lugton . .	16	17 50	50/56
13.2	*Shilford Box* .		21 30	51½
16.8	Barrhead . .	24	25 25	64½
21.1	Pollokshaws .		29 45	
—			p.w.s.	
22.5	Strathbungo .	31	33 35	
23.6	Gorbals . .		35 15	
			sig. stop	
24.4	ST. ENOCH .	35	39 25	

Net times: 67½ min. Dumfries—Kilmarnock
35 min. Kilmarnock—St. Enoch

Aberdeen—Glasgow express near Cove Bay, on the heavy ascent on the cliffs south of Aberdeen. The engine is a Balornock compound No. 1129

A one-time Kingmoor compound in unusual service in 1953; No. 41140 piloting an ex-L.N.E.R. 'B1' 4-6-0 on a Grimsby—Birmingham through train near Wigston

magnificently tuned up to test conditions, gave a number of readings of just over 1,000 horsepower (uncorrected) at a speed of 50 m.p.h. That 913 could virtually equal this, and what is more, sustain it for over half an hour is the finest tribute I can pay to a most remarkable piece of running. Even when we got to Kilmarnock there was still no help forthcoming, and the ascent of Stewarton bank, with several miles at 1 in 75, was equally fine. Here indeed was the optimum test performance of the compounds being realised in ordinary service in Scotland.

I may add that Driver Paterson and his fireman had no knowledge that so detailed a record was being taken of their work. It was not until I talked to them both on arrival at St. Enoch that they were aware so much stop-watching had taken place on the run. Except for the downhill stretch from Old Cumnock to Kilmarnock the effort had been sustained at a very high level throughout from Carlisle, and perhaps the finest feat of all was the absolutely sustained minimum speed of 43¼ m.p.h. on the 1 in 150 past Carronbridge, where the equivalent d.h.p. was 1,109.

Splendid though the work of the compounds was on the main line of the former Glasgow & South Western Railway, one of the most *difficult* assignments these engines ever had was on the Stranraer road. The main line, as on the run with No. 913 just described, could be mighty hard slogging. The Stranraer road, with its combination of severe curves and nightmare gradients, set drivers a tremendous task. With a load of only five coaches the steeply-graded switchback between Ayr and Girvan is not too bad; but on leaving Girvan the engine had to climb a gradient of 1 in 54, that continued unbrokenly for nearly 4 miles! On the Irish boat train engine No. 1069 gradually accelerated to 26 m.p.h. on this fearsome gradient, developing an equivalent drawbar horsepower of nearly 900 in the process. Then, after the steep descent to Pinwherry came an ascent of 8 miles, most of it between 1 in 67 and 1 in 70, with frequent curves, and here again in running at speeds of 30 to 34 m.p.h. the engine was developing over 900 equivalent drawbar horsepower.

After passing the summit at Milepost 16½ the gradients are favourable for the rest of the way to Stranraer.

It was one of the curiosities of compound allocation in Scotland that of the major running sheds, Balornock—adjacent to St. Rollox Works—was one of the last to receive its quota. It was indeed not until the year 1933 that engines 1126-9 were sent there from the L.N.W.R. section. Until that time

TABLE IV

AYR—STRANRAER: "THE FAST BELFAST"
Load: 20 axles, 163 tons tare, 175 tons gross
Engine: 3-cylinder Compound No. 1069

Dist. miles		Actual m.	s.	Speeds m.p.h.
0.0	AYR	0	00	
1.9	*Alloway Junc.*	4	30	32
3.3	*Dalrymple Junc.*	7	22	29
4.2	Dalrymple	8	47	64½ (max)
6.2	Cassilis	11	25	47/37½
9.0	Maybole	14	57	53/37½
13.4	Kilkerran	20	20	58/39
16.1	Dailly	24	11	56/39
19.8	Killochan	27	30	60
21.4	GIRVAN	31	16	
1.7	*Milepost* 2	6	23	19½
3.7	*Milepost* 4	11	53	26
4.9	Pinmore	13	45	—
—		—		60 (max)
8.1	Pinwherry	18	07	
1.6	*Milepost* 10	4	34	29½
4.1	Barrhill	9	06	34½
6.6	*Milepost* 15	13	52	30
8.1	*Milepost* 16½	16	21	44
—		—		61
12.6	Glenwhilly	21	08	33 (slack)
—		—		62
17.0	New Luce	27	18	
22.5	*Challoch Junc.*	34	00	
23.7	DUNRAGIT	36	33	
2.8	Castle Kennedy	4	55	
5.0	*Stranraer Junc.*	8	22	
6.1	STRANRAER HARB'	10	18	

the principal L.M.S.R. expresses between Glasgow and Aberdeen had been worked by ex-Caledonian engines, usually the Pickersgill 4—6—0s between Glasgow and Perth, and by superheater 4—4—0s of either McIntosh or Pickersgill design north of Perth. The arrival of the compounds at Balornock led to a rearrangement of the engine workings, so that Glasgow engines and men worked through to Aberdeen, and it was on one of these diagrams that I was privileged to ride on the footplate with that great Scottish driver, James Grassie, on compound No. 1127. I rode through from Aberdeen to Glasgow, but in deference to our heavy load a pilot was provided from Aberdeen to Forfar. This was a Caledonian 4—4—0 of the first 'Dunalastair' class, and with two engines the earliest stages of the run were not severe. But we were on our own from Forfar southwards, and although the work was not quite up to the most strenuous standards of the 1923-5 trials it was hard enough. The accompanying table (V) shows complete details as to how the engine was worked; that the effort was reasonably uniform, and sustained at a strenuous pitch throughout.

TABLE V

FORFAR—GLASGOW. "THE GRANITE CITY" EXPRESS

Load: 11 cars, 332 tons tare, 355 tons full

Engine: 3-cylinder compound No. 1127

Dist. Miles		Sch. mins.	Actual m. s.	Speed m.p.h.	Engine Working: Regulator	Cut-off HP	Cut-off LP
0.0	FORFAR	0	0 00		¼	79	71
0.7	*Forfar South Jc.*		2 15	—	Full	72	62
2.9	*Kirriemuir Jc.*	4	5 01	53	Full	67	55
5.7	Glamis		7 56	60	Full	67	55
7.9	Eassie		10 01	64½	Full	67	55
12.0	ALYTH Jc.	13	13 52	63½	Full	67	55
14.2	Ardler		15 56	65	Full	67	55
16.7	COUPAR ANGUS	17	18 14	65	Full	67	55
18.9	Burrelton		20 21	62½	Full	67	55
21.2	Cargill		22 32	71	Full	67	55
23.1	*Ballathie*		24 10	64	Full	67	55
25.3	STANLEY Jc.	25	26 16	62½	½	67	55
28.3	Luncarty		29 01	69	½	67	55
30.9	*Almond Valley Jc.*	31	31 39	—	Shut	—	—
			sig. stop	—	—	—	—
32.5	PERTH	35	41 17				
0.0		0	0 00				
			sig. stop	—	—	—	—
2.0	*Hilton Jc.*	4	5 50				
			6 30		Full	75	67
3.9	Forgandenny		10 10	48½	Full	67	55
6.8	Forteviot		13 29	53	Full	67	55
9.6	Dunning		16 36	54½	Full	75	67
11.3	*Milepost* 140		18 52	41½	Full	75	67
13.7	Auchterarder		22 43	32	Full	75	67
15.3	*Milepost* 136		26 05	28	Full	75	67
15.8	GLENEAGLES	26	27 10				
0.0		0	0 00		Full	75	67
2.2	Blackford	4	5 15	48	Full	67	55
4.3	Carsebreck		7 25	63½	Full	67	55
6.4	Greenloaning		9 27	65	Full	67	55
9.6	Kinbuck		12 20	66	⅗	84	77
12.3	DUNBLANE	14	14 55	—	almost shut	84	77
14.3	Bridge of Allan		17 04	51/62	Shut	84	77
17.2	STIRLING	20	20 43				
0.0		0	0 00		Full		
2.4	Bannockburn		4 43	42	Full	72	62
4.1	Plean		7 33	35½	Full	72	63
5.9	*Alloa Jc.*	8	9 36	62	⅘	72	62
8.1	LARBERT		11 58	55	⅗	72	62
9.3	*Carmuirs West Jc.*	12	13 14	60	Full	72	62
11.7	Greenhill	16	16 32	40	Full	72	62
12.3	*Milepost* 106		17 26	43	Full	72	62
13.5	Castlecary Box		18 57	50½	Full	72	62
15.1	*Milepost* 103¼		20 59	44½	Full	72	62
17.1	Cumbernauld		23 54	39	Full	72	62
18.8	*Madgescroft Box*		26 08	62	Full	72	62
21.2	GLENBOIG	28	28 36	56	⅗	72	62
23.0	Gartcosh	30	30 28	60	⅗	72	62
24.2	Garnkirk		31 40	60	Shut	72	62
			p.w.s.	—	⅗	72	62
26.8	Robroyston		35 52	—	Shut	72	62
29.2	St. Rollox	36	38 43	—	—	—	—
30.2	BUCHANAN ST.	41	41 48				

Glasgow—Euston express climbing to Beattock Summit, with compound No. 1136 piloting a Stanier 'Jubilee' 4-6-0

Dumfries—Stranraer train near New Galloway, in 1953, engine No. 41179

The next run for detailed mention in this Scottish section relates to the time when the compounds were being rapidly replaced from first-class express duty. Many Stanier 4—6—0s were at work, while at the same time the schedules of practically all express passenger trains had been considerably accelerated. The compounds, even if the new 4—6—0s had not come upon the scene, would have had difficulty in working their old trains to the new schedules. But there were some lighter duties, albeit at accelerated timings, for which 4—6—0s were not available, and the run detailed in Table VI is a splendid example of the work of one of the original Balornock quartet on the 2.15 p.m. summer Highland express in the late summer of 1938. A gross trailing load of only 195 tons certainly savours more of the Midland Railway in pre-grouping days than of the gargantuan tasks set to the compounds in Scotland, and no very hard work was demanded of the engine south of Stirling.

Because of the slight delays experienced up to this point we were a minute or so late away, and the driver, Jefferies of Balornock shed, put the engine to it really hard up the Dunblane bank. The gradient here is 1 in 100 from a point 2 miles out of Stirling to the tunnel just before Dunblane itself, and then 1 in 78 to 1 in 91 to within a mile short of Kinbuck. Speed fell to 41 m.p.h. on the steepest pitch, but recovered very smartly to 45 on the easier length to the summit point. Less strenuous working was needed over the gradually rising section from Kinbuck to the summit of the line just short of Gleneagles station, but the driver allowed the engine to go full tilt down the bank to Dunning, reaching and sustaining 82 m.p.h., and Hilton Junction, 31 miles, was passed in the smart time of 32¾ min. This was an excellent piece of compound running.

The next example of compound working in Scotland does not reveal any strenuous going from the viewpoint of horsepower output. But the road taken by the Edinburgh sections of the West Coast Anglo-Scottish expresses involves a very long and sustained climb from Princes Street terminus up to Cobbinshaw summit, an altitude of 880 ft. above sea level. The grading is at varying degrees of steepness as far as Midcalder Junction, after which it continues more steeply at 1 in 100 almost to Cobbinshaw. The run tabulated, with engine No. 1176, was made in the late summer of 1938, when the working of the afternoon service to London had been altered somewhat because of the introduction of the Coronation Scot from Glasgow. The Edinburgh through carriages, instead of being attached to what had previously been The Midday

TABLE VI

2.15 p.m. GLASGOW—PERTH

Load: 24 axles, 184 tons tare, 195 tons full
Engine: 3-cylinder compound No. 1128

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	BUCHANAN ST.	0	0 00	—
1.0	St. Rollox		3 48	—
3.4	Robroyston		9 09	32
—			sigs.	
9.0	Glenboig	15	17 09	—
13.1	Cumbernauld		22 13	56/43
16.7	Castlecary		26 08	62
20.9	*Carmuirs West Jc.*	29	30 22	66
22.1	LARBERT	31	32 02	
2.2	*Alloa Junc.*	3	3 40	58½
4.0	Plean		5 38	50
—			pitfall	25
5.7	Bannockburn		8 26	55
8.1	STIRLING	11	11 30	
1.8	*Cornton Box*		3 16	54
2.9	Bridge of Allan		4 30	50
4.9	DUNBLANE	8	7 08	44½
7.6	Kinbuck		10 50	41/45
10.8	Greenloaning		14 25	61½
15.0	Blackford	20	18 41	56
17.2	GLENEAGLES		21 04	56
19.3	Auchterarder		23 06	72
23.4	Dunning		26 18	82
26.2	Forteviot		28 29	73
29.1	Forgandenny		31 00	64½
31.0	*Hilton Junc.*	36	32 48	60
33.0	PERTH	41	37 08	

TABLE VII

1.40 p.m. EDINBURGH—SYMINGTON

Load: 24 axles, 195 tons tare, 205 tons full
Engine: 3-cylinder compound No. 1176

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	PRINCES ST.	0	0 00	—
1.2	Merchiston	3	3 20	—
2.2	Slateford		4 39	43½
3.0	Kingsknowe		5 59	38
5.5	Currie Hill		9 52	41
7.4	*Ravelrig Junc.*		12 41	39
10.1	Midcalder		16 44	44½
11.3	*Midcalder Junc.*	19	18 23	42
15.4	Harburn		25 22	34
17.1	*Milepost* 84		28 24	32½
18.4	Cobbinshaw	29	30 46	37
21.5	Auchengray		34 09	62½
—			eased	
25.8	Carnwath		38 39	50
27.4	*Strawfrank Junc.*	41	41 06	20 (slack)
32.1	Thankerton		46 58	55
33.7	SYMINGTON	50	49 23	

Scot, were attached at Symington to the afternoon London express from Perth. The engine kept good time out to Midcalder Junction, but the point-to-point allowance of only 10 min. for the 7.1 miles up to Cobbinshaw was disproportionately sharp. The driver knew well that he could afford to lose a little time on this section, with the easy timing of 12 min. from Cobbinshaw to Strawfrank Junction to follow. With the easiest of downhill running and careful negotiation of the sharp curves on the south side of Carstairs he passed Strawfrank on time, and was slightly ahead on arrival at Symington.

Table VIII shows details of a splendid run with one of the Polmadie compounds working south from Carstairs to Carlisle with a load of no less than 420 tons. Although this big train was taken over Beatock summit without assistance the worst of the climbing in the southbound direction occurs between the crossing of the Clyde at Uddingston and Craigenhill box.

The ascent of Upper Clydesdale is on easier gradients until the final 2½ miles to Beattock

TABLE VIII

CARSTAIRS—CARLISLE
Load: 58 axles, 397 tons tare, 420 tons full
Engine: 3-cylinder compound No. 901

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	CARSTAIRS .	0	0 00	—
3.5	*Leggatfoot Box* .		6 55	—
6.7	SYMINGTON.	10	11 20	39
10.4	Lamington .		15 30	65
15.7	Abington . .		21 00	—
18.2	Crawford . .		24 00	47½
20.9	Elvanfoot .		27 35	49
23.8	*Summit* . .	33	32 00	29¾
—	*Greskine* . .		—	70½ (max)
33.8	BEATTOCK .	44	43 20	
5.2	Wamphray .		6 50	66
11.0	Nethercleugh .		12 10	—
13.9	LOCKERBIE .	14	14 55	—
17.0	*Castlemilk Box* .		18 10	—
23.0	Kirtlebridge .	23	23 35	74
26.7	Kirkpatrick .		27 10	—
31.1	Gretna Jc. .	32	31 10	66½
35.6	Rockcliffe . .		35 20	
39.7	CARLISLE .	42	40 55	

One of the first short-chimneyed twenty, No. 1083 as originally built with right-hand drive

A well-known Kingmoor compound, No. 1069 equipped for oil firing

summit, where the grade is 1 in 99. Furthermore that last steep pitch can be more or less rushed, from a speed of 50 m.p.h. or more on the short level stretch past Elvanfoot. This is not in any way to lessen the achievements of engine No. 901, as set out in Table VIII, but to make clear that crossing Beattock summit southbound is not the tremendous tug-of-war that it is in the opposite direction.

Engine No. 901 gained a minute on schedule during the ascent, and although the ensuing section from the restart at Beattock is favourable in the aggregate, it needed very smart working of a 4—4—0 locomotive to pass Rockcliffe in even time from Beattock.

Next, in Table IX, comes a further interesting example of working on the Aberdeen road, with a Kingmoor engine, No. 1143, working south on the 6.45 a.m. up express to Euston. I was staying at Stonehaven in the summer of 1929, and spent many hours studying the locomotive and train working at a particularly interesting time in the evolution of locomotive practice, on both the L.M.S.R. and the L.N.E.R. On the up road the compounds had three double-home turns to Carlisle. In addition to this early morning train, which also carried a portion for Glasgow, they had the up Postal and The Royal Highlander. The 6.45 a.m. was perhaps the hardest of them all, because the train ran to the sharp point-to-point times of the Glasgow—Aberdeen expresses of that time, as far south as Perth, and there collected a dining car, and a through portion from Dundee to Euston.

The load was really heavy from Perth to Stirling, but at the latter point the Glasgow portion was detached, and transferred to the first morning express up from Oban. While these turns were normally operated by Kingmoor and Aberdeen engines on alternate days there were times when the workings got mixed up, and in that same summer I travelled north from Stirling one day behind compound No. 1186, then stationed at Low Moor L. & Y. section !

On the run set out in Table IX, engine No. 1143 had to be worked hard to keep the point-to-point times between Stonehaven and Coupar Angus. The sharp staccato of her exhaust on the banks, and the rapidity with which the driver got her away once each summit point was passed, showed clearly that there was little to spare. It was only when she was well into speed on the level between Forfar and Coupar Angus that any appreciable easing took place. Then came the increasing of the load at Perth, to no less than 371 tons tare. Here of course the problem was the ascent from Dunning to Gleneagles, almost entirely at 1 in 100.

TABLE IX

7.9 a.m. STONEHAVEN—STIRLING

Load : to Perth, 244 tons tare, 260 tons full, to Stirling, 371 tons tare, 395 tons full
Engine: 3-cylinder compound No. 1143

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	STONEHAVEN	0	0 00	—
0.9	*Milepost 224*		2 50	28
2.6	*Dunnottar*		6 10	32/40
4.7	*Milepost 220¼*		9 25	36
7.2	Drumlithie		12 40	58
11.2	Fordoun		16 15	72
14.5	LAURENCEKIRK	20	19 45	
3.2	Marykirk		5 20	62
5.3	Craigo		7 15	71½
7.4	*Kinnaber Jc.*		9 25	56/60
8.6	DUBTON JC.	11	11 05	
2.7	Bridge of Dun		4 00	60
5.8	Farnell Road		7 20	51
9.1	Glasterlaw		12 00	37½
15.7	Clocksbridge		19 20	60
18.1	FORFAR	24	22 30	
2.9	*Kirriemuir Jc.*		4 55	57
5.7	Glamis		7 40	62
7.9	Eassie		9 40	67
12.0	ALYTH JC.		13 25	65
14.2	Ardler		15 25	66½
16.7	COUPAR ANGUS	18	18 10	
4.5	Cargill		6 55	64½/56
8.6	Stanley Jc.		11 05	58
			sigs.	—
15.8	PERTH	20	22 05	
2.0	*Hilton Jc.*		5 50	
3.9	Forgandenny		8 10	52½
6.8	Forteviot		11 30	53½
9.6	Dunning		14 45	49½
11.3	*Milepost 140*		17 20	36
13.7	Auchterarder		22 20	25
15.3	*Milepost 136*		26 55	19½
15.8	GLENEAGLES	25	27 55	
2.2	Blackford		6 45	47½
6.4	Greenloaning		11 10	64/61
9.6	Kinbuck		14 15	64½
12.3	DUNBLANE		17 00	slacks
14.3	Bridge of Allan		19 00	66
17.2	STIRLING	22	22 40	

A study of the log, and the adjoining speeds, shows at once that the hill-climbing was a long way below the standards set in the famous test runs over the Leeds—Carlisle line, and that against speeds of 25 to 30 m.p.h. with tare loads of 350 tons, on such gruelling ascents as from Settle Junction to Blea Moor, and Appleby to Aisgill, No. 1143, on a much shorter incline, fell to 19½ m.p.h., and lost all but 3 min. from Perth to Gleneagles. Nevertheless the conditions are not by any means comparable.

Engine No. 1143 was engaged on a through working of 240 miles. She had already covered nearly 90 miles, at a smart pace. Had she been really extended, in an attempt to keep strict time between Perth and Gleneagles, it would have needed a tremendous build up of the fire, with the risk of either tearing it to pieces, or worse still developing leaky tubes. Then, immediately following this heavy work came the easy stretch to Stirling. In my opinion the driver was entirely correct in not unduly pressing his engine up to Gleneagles. By so doing he kept the rate of demand on the boiler more even, and kept the fire and the steaming steady and in first class shape. Similarly the engine was not unduly pounded in the restart from Gleneagles, where the severe bank continues from the first half-mile. After that they ran well to Stirling, descending Dunblane bank in traditional Caledonian style, with speeds not greatly exceeding 60 m.p.h. These runs between them combine to give a good impression of compound performance in Scotland in a period of great distinction.

Figures alone, however, cannot really complete the picture, and my own memory is full of vivid recollections of these engines at work. At a time when the decree had gone forth that the great majority of pre-grouping locomotives should be painted in unlined black the compounds were resplendent in 'Derby-red', and usually kept very clean. At one time they were the only red engines working north from Glasgow, if one excepts the 'Royal Scots' that came north on the double-home night runs from Crewe to Perth. And then there was their actual working : they were such 'live', willing engines; so dynamic to ride upon ! The detailed account of the run with 'The Granite City' express, in Table V, on page 119, gives a very full technical exposition of a compound at its best; but one needed to be on the footplate to absorb fully the 'character' of the engine. Number 1127 was a lively thing on the road—not rough, but having an action like a strong mettlesome horse. If one had tried merely to travel upon her, as in a coach, journey's end would have been

attained with a welter of bruises. One had to 'ride' her : to be poised and braced for her swings and rolls; to anticipate her lurches, and then her going was exhilarating beyond measure.

She caught me unprepared, with a hearty lurch at Kinnaber Junction, while we were still double-headed; but by the time we got to Forfar I had taken her measure, just as I had absorbed the interesting techniques of starting and driving her. There were no amenities in the cabs of the compounds; no seats, not even a really comfortable stance, though they were not so bad in this respect as were the Midland 7 ft. Class 2 superheater 4—4—0s, on which the reverser handle was almost level with the very back of the cab. But in Scotland, in the high-noon of the compounds, there was little chance for anyone to sit down while on the run. Engines and men had to work too hard, though in their prime, in relation to the work they did, the compounds were never excessive coal burners. So far as my own experience goes the two greatest runs I ever had with compounds took place in Scotland, and as set down here, in Tables III and V, the runs of No. 913 and No. 1127 will repay the closest study.

Glasgow—St. Pancras express leaving Carlisle hauled by engine No. 1071, stationed at Leeds

CHAPTER 10

HIGH NOON OF THE COMPOUNDS: THE NORTH WESTERN AND MIDLAND LINES

The building of the 'Royal Scot' class 4—6—0s, in 1927, went a considerable way towards smoothing out many of the differences that had set Derby against Crewe in the early days of the amalgamation. Again, the Midland compounds had been drafted on to the North Western section in such numbers that there was little opportunity for instructing the men. One of my friends who was very deeply concerned with motive power matters on the L.M.S.R. at that time has told me that even with the more intelligent of the drivers there was a natural reluctance to open the regulator to the full; and in riding on the footplate he had many times to take the regulator himself, and show them what happened when the handle *was* pushed fully open. Then, drivers and firemen alike were astonished at the dynamic change that came over the locomotive, and they never failed to be delighted by the freedom and ease with which the engines then did their work.

On the North Western, after the year 1927, their top link work was largely confined to the Euston, Birmingham and Wolverhampton trains. The introduction of the 'Royal Scots' on the Anglo-Scottish expresses, and some of the Liverpools, led to a rationalisation of express workings in other directions, and instead of the indiscriminate use of all types of superheater engines that had characterised the early L.M.S. days, selected batches of 'Claughtons' were set aside for the Irish Mails, the Manchesters, and those Liverpool trains for which 'Royal Scots' could not be provided. Rugby shed ceased to play a major part in the main line express workings, and the only part the compounds came to play in these intermediate years was that of piloting. It was then that compounds began to appear on cross-country services of the North Western section, including the West to North expresses taken over from the Great Western at Shrewsbury. As related in the previous chapter, some engines from the London and North Western section were transferred to Scotland, but in the south, with the exception of the London—Birmingham—Wolverhampton trains, there was a tendency for the compounds to drift on to second-class duties.

On the Midland division, by the year 1927, they were working over the entire system. This reacted much to the improvement of running over the West of England line, which in earlier years had to rely very largely upon engines of No. 2 class. In the first years of grouping many important trains were run by non-superheater rebuilds of the Johnson 4—4—0s, and the crack engines regularly working south-west of Derby were a relatively few No. 3 class superheated Belpaire 4—4—0s. The coming of the compounds brought a new energy and purpose to the West of England workings, which, it must be admitted, had previously been characterised by coal-dodging methods of driving, so far as the men at the south-western end of the line were concerned. The stationing of compounds at Derby also meant that practically all the expresses over the Manchester line, *via* Peak Forest, could be allocated to engines of No. 4 class. In the late nineteen-twenties Leicester, Nottingham and Millhouses (Sheffield) all had their quota of compounds, while on the West of England line, in addition to Derby and Bristol, there were three of them stationed at Gloucester.

But the introduction of the 'Royal Scots' had another effect. It made some of the 'Claughtons' surplus to requirements and in the summer of 1928 one of these engines, No. 6025, was transferred to the Midland permanently. Previously there had been some temporary transfers, but mainly to enable the experimental section of the Derby drawing office to observe the results of detail modifications. The transfer of No. 6025 was the first step, so far

An official photograph showing the experimental block lettering style, as applied to engine No. 1094

as the Midland Division was concerned, in a policy of further motive power rationalisation. Despite the excellent work that the compounds had done in the various trials from 1923 onwards it had not been found possible to increase their rostered loads much above the old limits, as an all-the-year-round proposition, and there was still a good deal of piloting being done, especially in the North.

The transfer of a batch of 'Claughtons' to the Midland Division enabled the loads of the principal expresses to be increased, when necessary, without so much recourse to piloting, and the North Western engines began to take over the principal workings between Leeds and Carlisle. The wheel was indeed tending to turn full circle. Moreover, the relatively simple modifications that had been made to the piston valves greatly reduced the coal consumption of the 'Claughtons'—indeed, in some tests made with engine No. 6001 in 1930 the basic coal consumption, in pounds per drawbar horsepower hour, was even less than that of the compound No. 1008, in 1923, on the same two trains.

Nevertheless, on the Midland main lines, south of Leeds and south-west of Derby, the compounds were to reign supreme for several years to come, and although they never seemed to rise to such dazzling heights on their parent system as they did in Scotland much of the work done between the years 1927 and 1933 was vastly above the standards one would have expected from the same engines in the greatest days of the Midland Railway. Many runs that I clocked personally were characteristic of this period, and from my old notebooks I have picked out some that are quite representative, but which would have been considered outstanding ten years earlier.

Another experimental lettering style, on engine No. 1099

Compound on express goods service: engine No. 1102 northbound approaching Elstree

I have first of all tabulated a pleasant run on the 'Thames—Clyde Express' in the late summer of 1931. Until a few months prior to this journey the train had made a non-stop run from Leeds to Trent, and in deference to the many slowings for pitfall and other engineering hindrances that then beset this route the 76.2 mile run was allowed 99 min. On my last trip on the non-stop schedule engine No. 1059, hauling a load of 330 tons, kept exact time, despite a succession of checks that cost us at least 7 min. in running. But at the time of the journey tabulated the train had been diverted *via* Sheffield; harder work was involved, while we enjoyed a much clearer run on the main line, and were able to make some pleasantly brisk speed over much of the route. At that time, of course, a load of 275 tons would not be considered very much for a compound anywhere else on the L.M.S. system. As a further sign of changing times we had been hauled from Carlisle to Leeds by the pioneer L.N.W.R. 4-cylinder 4—6—0 *Sir Gilbert Claughton* and with a 335-ton load had been delivered in Leeds 3 min. early.

In studying the run of No. 1049 readers may also be interested to turn back to Chapter Three, in which there is tabulated a run with the old 3.40 p.m. up from Leeds, non-stop to St. Pancras, when the schedule time to passing Rotherham was 39 min. On my own run of 1931 engine No. 1049 got a remarkably clear road. The gradients are very

TABLE I

L.M.S.R. 2.30 p.m. LEEDS—TRENT

Load: 253 tons tare. 275 tons full
Engine: 3-cyl. compound No. 1049

Dist. miles		Actual m. s.	Speeds m.p.h.
0.0	LEEDS	0 00	—
1.8	Hunslet	4 05	—
7.6	Methley	10 30	62
10.9	NORMANTON	14 25	15*
14.8	Sandal	20 25	54
20.9	CUDWORTH	26 45	64½
24.6	Darfield	30 12	67
28.9	Swinton	34 15	58
32.0	Parkgate	37 17	62
34.0	ROTHERHAM	39 30	15*
		sigs.	
39.5	SHEFFIELD	48 10	
1.4	Heeley	4 00	26
4.2	Dore and Totley	9 50	31½
6.9	Dronfield	14 25	60
10.5	Sheepbridge	17 45	69
		p.w.s.	30*
12.2	CHESTERFIELD	19 25	
		p.w.s.	
16.4	CLAY CROSS	25 15	35*
19.8	Doe Hill	30 45	40
22.4	Alfreton	33 30	60
		p.w.s.	25*
24.9	Pye Bridge	37 45	
33.2	Trowell	46 45	67
37.7	Long Eaton	51 50	
38.6	TRENT	53 35	

*Speed restrictions

slight as far as Altofts, but then there is a pronounced rise up to Royston Junction, at 1 in 355. Originally, of course, this was intended to be as fast a main line as the London and Birmingham. Laid out by George Stephenson himself, the North Midland was one of the finest of his works; but his deliberate policy of tapping all the coal-bearing regions led eventually to the imposition of many slacks for colliery workings, and the speed of the through trains had tended to become slower and slower. The service slack through Normanton was not dictated by any particular local geography but by the way the track layout was allowed to sprawl, with the growth of business. The accent was always on freight, and it never seemed to occur to anyone to re-align the through lines so that the express passenger trains could run through at full speed.

Engine No. 1049 with her 275-ton load topped Royston summit at 53 m.p.h. and then put on a good spurt down past Cudworth, sustaining 67 m.p.h. and keeping on at around 60 m.p.h. until slacking heavily at Rotherham Masborough to take the Sheffield line. The restart from Sheffield takes the train, in less than half a mile, on to a 1 in 100 ascent that continues without a break for $5\frac{1}{2}$ miles to the south end of Bradway tunnel. Here speed was worked up to 32 m.p.h., and on the corresponding descent to Chesterfield a maximum of 69 m.p.h. was touched. Trains from the Sheffield direction normally have the advantage of those from the North Midland main line at Tapton Junction in taking the straight road, but on this occasion there were permanent way checks on either side of Chesterfield, followed by the usual slack at Clay Cross to diverge from the North Midland line to that leading to the Erewash Valley. The slack at Clay Cross was to 35 m.p.h., after which speed was worked up to 40 m.p.h. on the $2\frac{3}{4}$ miles of 1 in 160 to Doe Hill Summit. Again we enjoyed the luxury of a relatively unchecked run down through the colliery areas, and our total running time from Leeds to Trent was only $101\frac{3}{4}$ min., including the diversion *via* Sheffield, and stopping and starting at the latter place.

The drafting of a number of 'Claughtons' to the Midland Division from 1928 onwards resulted in several of the best known of the compounds leaving their traditional stations. The two original Johnson engines of 1902, for example, which throughout their existence, whether as 2631-2, or 1000 and 1001, had been at Leeds, were transferred with No. 1002 to Gloucester, and the other two Johnson engines 1003 and 1004 went to Leicester. The pioneer Deeley engine, originally No. 1000, and then 1005, went to Sheffield Millhouses shed, and I came across this engine early one August morning

Engine No. 1101 on the same duty: an interesting use of express passenger 4-4-0s on a fully fitted service

in unexpected circumstances. I was travelling north, to spend a weekend in the Lake District, and for some reason that I cannot remember travelled down from St. Pancras on the 2.25 a.m. Manchester train. We were worked down from London by a 'Claughton', and at Leicester, at 4.35 a.m. on a summer's morning, No. 1005 came on to an increased load of 305 tons. She made the excellent run to Derby, detailed herewith (Table II)—another example of the way compound drivers on the Midland were tackling far heavier loads than would have been permitted, without a pilot, in former days.

TABLE II

L.M.S.R. 4.35 a.m. LEICESTER—DERBY
Load: 282 tons tare, 305 tons full
Engine: 3-cyl. compound No. 1005

Dist. miles		Actual m. s.	Speeds m.p.h.
0.0	LEICESTER	0 00	
4.7	Syston	7 05	61½
9.8	Barrow	11 55	68
11.4	*Milepost* 100½	13 20	68
12.5	LOUGHBOROUGH	15 00	
2.8	Hathern	5 15	51
4.7	Kegworth	7 25	58½
7.8	*Trent Junc.*	10 20	65
8.9	*Sawley Junc.*	11 35	50 (slack)
10.9	Draycott	13 55	54
14.4	Spondon	17 40	58½
		sigs.	
17.0	DERBY	22 10	

On the continuation of this journey to Manchester the load was reduced to one of only seven coaches, with a gross load of 205 behind the tender. But the performance, as shown in the accompanying Table III, was extremely fine in the climbing from Rowsley to Peak Forest. The initial checks cost us a good 6 min. to Ambergate compared with the ordinary standards of running, and the speed along the winding valley of the Derwent was just about as fast as possible—for comfort! Then the driver paid scrupulous attention to Rowsley curve, where other compound drivers had taken us round at an unchecked 60 m.p.h. Such a slack could have been a sorry handicap in starting the long and arduous climb to Peak Forest; but this driver put engine No. 933 to it with tremendous vigour, and we averaged 43 m.p.h. throughout. Again this driver resisted the temptation to use his fine speed of 52 m.p.h. through Millers Dale to charge the final three miles at 1 in 90 up to Peak Forest, and he eased his engine slightly to take the right-hand fork at Millers Dale Junction. The sustained speed of

TABLE III

L.M.S. 5.28 a.m. DERBY—MANCHESTER
Load: 189 tons tare, 205 tons full
Engine: 3-cylinder compound No. 933

Dist. miles		Actual m. s.	Speed m.p.h.
0.0	DERBY	0 00	—
3.2	*Little Easton Jc.*	5 45	50
5.2	Duffield	8 05	53
7.8	Belper	11 50	sig.
		12 40	stop
—		p.w.s.	
10.4	Ambergate	19 50	
13.4	*High Peak Jc.*	23 15	63½
17.1	MATLOCK	27 55	59
19.3	Darley Dale	30 00	64½
21.6	Rowsley	32 25	34*
23.5	*Haddon*	35 45	38½
24.9	Bakewell	37 40	47
27.3	Great Longstone	40 50	44
28.7	Monsal Dale	42 30	53/44½
31.4	MILLERS DALE	45 55	52
33.4	*Milepost* 161¼	48 30	40*
36.0	Peak Forest	52 35	39
39.7	Chapel-en-le-Frith	56 50	64½
41.6	CHINLEY	59 05	60
44.3	*New Mills South Junc.*	61 45	56
49.4	Hazel Grove	66 40	73
		sigs.	
53.4	CHEADLE HEATH	70 45	
58.3	Chorlton-cum-Hardy	76 25	57½
		sigs.	
61.4	MANCHESTER CNT.	83 25	

*Speed reduced by brakes.

Engine No. 1191 on Lancashire and Yorkshire duty leaving York with an express for Manchester

Compound No. 936, with high-sided tender, near Cromford, Derbyshire

39 m.p.h. subsequently held unvaryingly up the 1 in 90 Peak Forest represented an equivalent drawbar horsepower of 930. In any case the net time of 46½ min. for the 36 miles from Derby to Peak Forest was an admirable piece of work. At this distance in time I am very glad I managed to stay awake during this overnight journey to record the running in the detail set down in my old notebook.

In passing to south-west of Birmingham we pass also from what might be termed 'standard' compound running in the later L.M.S. days to the superlative. The accompanying table, IV, sets out details of a run with No. 936 on the 3.29 a.m. express from Cheltenham to Birmingham, with a load of 310 tons. The timing was then very sharp, with only 31 min. allowed for the 31.1 miles from Lansdown station to the bank engine stop at Bromsgrove South. Inclusive of this, and of the ascent of the Lickey Incline, the overall average speed booked from Cheltenham to Birmingham was 50.6 m.p.h. The start out of Cheltenham is downhill, mostly at 1 in 300 almost to Ashchurch, but it nevertheless needs hard driving to cover the first 7.3 miles in 8 min. 8 sec., and to work speed up to 72 m.p.h. in this distance. After that the tendency is wholly adverse; yet the 21.9 miles from Ashchurch to Stoke Works Junction were covered at an average speed of 68.6 m.p.h., and 1¼ min. was

TABLE IV

L.M.S.R. 3.29 p.m. CHELTENHAM—BIRMINGHAM

Load: 292 tons tare, 310 tons full
Engine: 3-cylinder compound No. 936

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	CHELTENHAM (LANSDOWN)	0	0 00	—
0.8	*High St. Goods*		1 51	—
3.8	Cleeve		5 08	62
7.3	ASHCHURCH	8	8 08	72
9.4	Bredon		9 59	68
12.1	Eckington		12 16	73
13.2	Defford		13 10	71½
16.7	Wadborough		16 12	66½
18.0	*Abbots Wood Jc.*	18	17 23	66
20.5	*Spetchley Box*		19 38	67½
26.5	*Droitwich Road Box*		24 58	70½
29.2	*Stoke Works Jc.*		27 16	63
31.1	BROMSGROVE*	31	29 40	
		32	31 08	
33.5	Blackwell	38	38 19	21
35.0	Barnt Green		40 36	46
38.6	Northfield		44 28	66½
40.0	KINGS NORTON		45 49	46†
42.2	Selly Oak	48	48 26	54
44.6	Five Ways		51 46	
45.5	BIRMINGHAM (NEW STREET)	54	53 55	

*Bank engine stop: 0–6–0 No. 7236 in rear
†Speed restriction

clipped off the most exacting schedule to Bromsgrove. The gradient averages about 1 in 600 against the engine between Cleeve and Stoke Works, and here the equivalent drawbar horsepower was about 890—a high figure for a compound at this speed. Only one 0—6—0 tank engine was provided to assist up the Lickey Incline, and a minute was lost on the ascent; but because of the gain in time to Bromsgrove, Blackwell was passed practically on time, and No. 936 was then taken smartly into Birmingham to arrive 'on the dot'.

The superseding of the compounds on the main line to St. Pancras began in 1932 when the 'Baby Scots' were introduced, while the drafting of many Stanier 4—6—0s to the Midland Division in 1935 saw an end of their working on crack trains south of Leeds. Up to 1933, however, some very fine work was done, with greatly increased loads on the old 'Special Limit' timings, and I have chosen two for special mention. The first (Table V) was one of my own recording, on the up 'Thames—Clyde Express' from Leicester to St. Pancras, with one of the original Johnson compounds, No. 1003, and a 275-ton load. We were away from Leicester dead on time, and the immediate start out to Wigston was inclined to be slow. Scrupulous attention was paid also to the speed restriction round the curve at that station. But from there onwards No. 1003 and her crew put up a grand show. It was notable that the 71.7 miles from Great Glen to St. Albans should be covered in 69½ min. having regard to the steep gradients of the line, to the slack at Market Harborough, and to the fact that this fine average had been made before the really favourable part of the road begins. In fact the train was running so comfortably ahead of time when St. Albans was passed that a pronounced easing had already commenced before we got involved in signal checks. Nevertheless, although this run was made immediately after a Bank Holiday we stopped in St. Pancras virtually 'on the dot'.

TABLE V

L.M.S.R. 4.48 p.m. LEICESTER—ST. PANCRAS

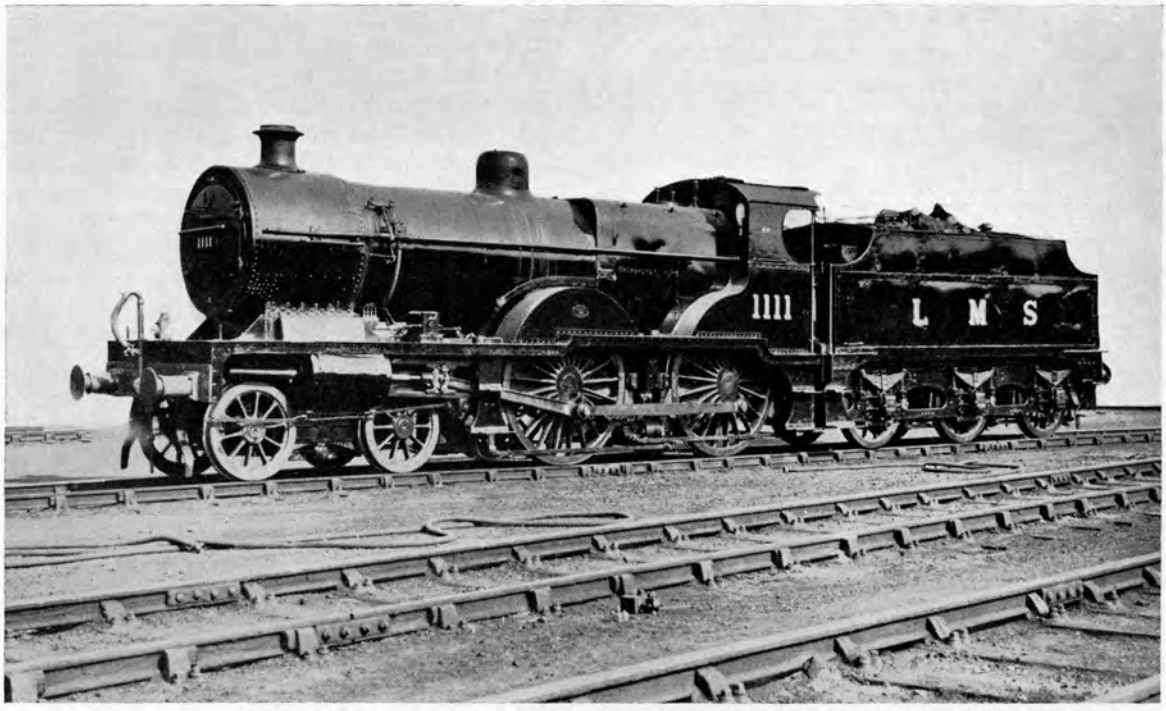
Load: 253 tons tare, 275 tons full
Engine: 3-cyl. compound No. 1003

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.s.
0.0	LEICESTER	0	0 00	—
1.2	*Knighton North Jc.*		3 36	—
3.7	Wigston Magna		7 20	45*
7.5	Great Glen		12 15	53
9.4	*Kibworth North*		14 30	48½
12.8	East Langton		17 40	75
16.2	MARKET HARBOROUGH	20	20 45	50*
20.6	*Desborough North*		27 00	39
23.5	Glendon		30 00	71
27.1	KETTERING	32	33 00	76½
29.8	Burton Latimer		35 10	69
34.1	WELLINGBOROUGH	39	38 45	74
39.4	*Milepost* 59¾	45	44 05	45½
42.4	Sharnbrook		47 10	82
49.3	BEDFORD	54	52 25	72
57.3	Ampthill		60 10	52½/59
61.8	Harlington		65 00	53½
65.1	*Milepost* 34		68 47	50
68.9	LUTON	76	72 40	68½/64½
71.8	Chiltern Green		75 15	72½
74.5	Harpenden		77 35	69/67
79.2	ST. ALBANS	86	81 45	70½
83.9	Radlett		85 55	eased
			sigs.	5
86.7	Elstree		90 50	—
92.2	Hendon	98	97 02	70½
97.6	Kentish Town	104	103 30	
			sigs.	5
99.1	ST. PANCRAS	107	107 15	

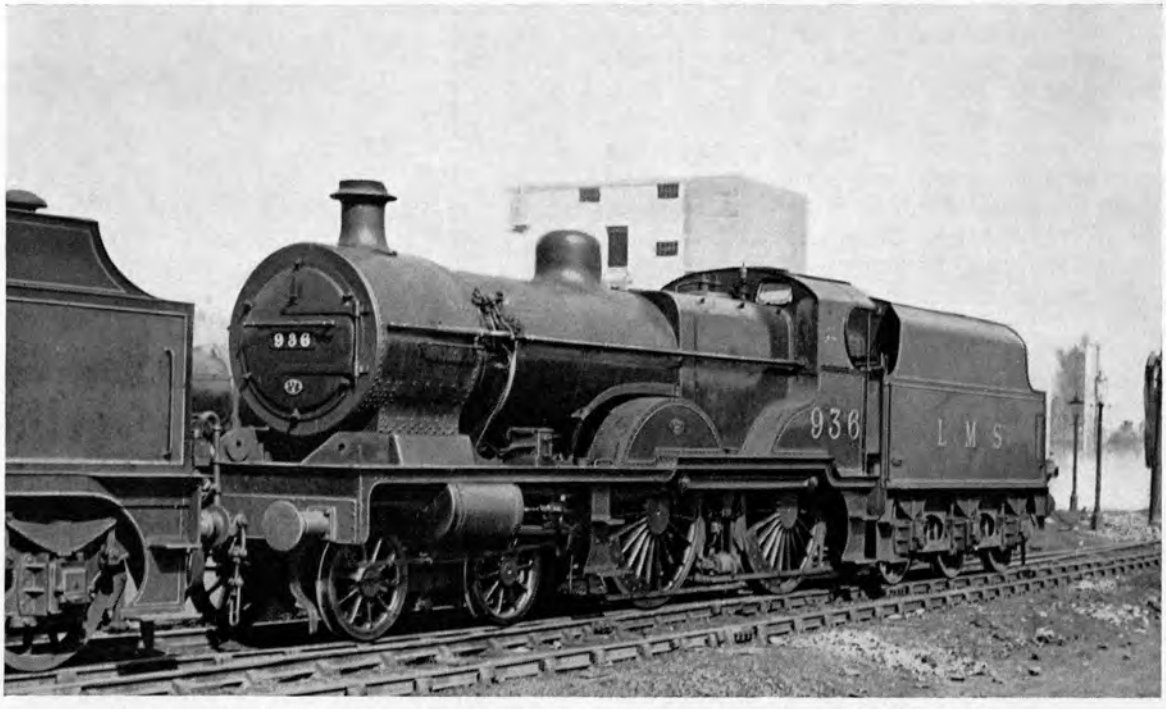
*Speed restrictions

Engine No. 936—still with its high-sided tender, as B.R. No. 40936, passing Tring with an up Birmingham excursion in 1953

The second run (Table VI) was clocked by the late Mr. E. L. Diamond, author of the notable paper to the Institution of Mechanical Engineers referred to in Chapter Seven. It was made with the famous engine of the 1923 dynamometer car trials between Leeds and Carlisle, the engine which—more than any other—influenced the extensive building of the compounds as an L.M.S. standard class. This run was made in 1926, and at that time such a load as 270 tons tare was a very unusual one to be taken without a pilot on the



Compound No. 1111, in plain unlined black; one of a few engines of the class fitted with flat coupling rods by Sir William Stanier



One of the last batch of compounds to be built, but including two variations: tall Midland chimney, and Stanier high-sided tender

TABLE VI

L.M.S.R. 5 p.m. ST. PANCRAS—KETTERING

Load: 270 tons tare, 290 tons full
Engine: 3-cylinder compound No. 1008

Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.
0.0	ST. PANCRAS	0	0 00	
1.5	Kentish Town	4	4 35	
3.5	Finchley Road		7 55	38½
6.9	Hendon	10	12 05	62
12.4	Elstree		17 55	53
15.2	Radlett		20 30	75½
19.9	ST. ALBANS	24	24 35	60
24.6	Harpenden		29 15	
27.3	Chiltern Green		31 40	75½
30.2	LUTON	34	34 05	
32.8	Leagrave		36 20	65½
37.3	Harlington		40 10	79
40.2	Flitwick		42 25	82
41.8	Ampthill		43 35	75/77
49.8	BEDFORD	52	50 05	73
53.0	Oakley		53 10	62
56.7	Sharnbrook		56 40	66
59.7	*Milepost* 59¾	63	60 20	48
62.7	Irchester		63 15	73
65.0	WELLINGBOROUGH	68	65 15	eased
68.3	Finedon		68 40	
72.0	KETTERING	76	73 45	

Midland Division, despite all that had been achieved in the trials further north. Once again the start was inclined to be slow, and a clear 2 min. was dropped to Hendon. But by that time the engine was going in her Aisgill form of 1923, and her minimum speeds of 53 m.p.h. at Elstree and 60 m.p.h. above St. Albans indicated that some very hard driving and firing was in progress on the footplate. Even though Radlett had been passed at 75½ m.p.h. the ascent past St. Albans includes 4½ miles continuously at 1 in 176. The boiler must have been steaming perfectly, for following this hard climbing effort some unusually fast running was made across the undulating tableland to Leagrave Summit.

Luton was passed dead on time, and the descent towards Bedford was commenced like the proverbial bomb. Despite some easing farther down the bank Sharnbrook station was passed in even time from the start, and the 'flying' average of exactly 70 m.p.h. over the 49.8 miles from Hendon to Sharnbrook was an outstanding achievement for a Midland compound by any standard of assessment—let alone in those days before the Midland drivers generally had really found what they could do with these engines. With a very hard climb of Sharnbrook bank—3 miles at 1 in 119—and a swift descent to Irchester there was time enough for an easy finish and an arrival at Kettering 2¼ min. early.

On the North Western, after their use on the

TABLE VII

L.M.S.R. 10.30 p.m. SHREWSBURY—CREWE

Load: 353 tons tare, 385 tons full
Engine: 3-cyl. compound No. 1132

Dist. miles		Actual m. s.	Speeds m.p.h.
0.0	SHREWSBURY	0 00	—
—	*Milepost* 28½	—	24½
4.6	Hadnall	10 55	54½
7.2	Yorton	14 10	49½
10.7	Wem	17 45	63
14.0	Prees	21 00	60
18.9	WHITCHURCH	26 05	55½/57
—	*Milepost* 12	—	53
23.8	Wrenbury	30 55	74/69
28.2	Nantwich	34 40	75
29.8	Willaston	36 20 sigs.	
32.7	CREWE	41 15	

Manchester—Llandudno express at Colwyn Bay, hauled by engine No. 1093 (with Stanier chimney)

Liverpool—Llandudno express, approaching Llandudno; engine No. 1118

Manchester expresses, attention was focussed mainly on their work with the Wolverhampton trains. For my own part I did have a number of interesting experiences on other parts of the line that are still worth setting on permanent record. In night journeys to the north I had several trips on the 10.30 p.m. mail from Shrewsbury to Crewe; but the occasions on which I was travelling were usually ones of unusually heavy traffic and the train was often divided. But at Whitsun 1929 we had an undivided train of 385 tons, and compound No. 1132 made the good run tabulated herewith. The climb out to Hadnall is mostly on 1 in 117, and with such a train it was reasonably good work to hold 25 m.p.h. to the summit. After that the gradient undulates with a rising tendency to Whitchurch, and the average speed of 56.6 m.p.h. maintained from Hadnall to Whitchurch was excellent .The last half-mile at 1 in 136 up to Milepost 12 was cleared at 53 m.p.h. Then came some fast running down to Nantwich, with a top speed of 75 m.p.h., but a signal check at the finish prevented us from making a 40 min. run from Shrewsbury to Crewe.

Before coming to an account of compound working on the Birmingham two-hour trains special mention must be made of a remarkable performance by engine No. 1054 in 1928. It was in that year that competition between the East Coast and West Coast routes to Scotland reached a further stage in length of non-stop run. In the previous summer the L.N.E.R. had booked the relief portion of the 'Flying Scotsman' non-stop from Kings Cross to Newcastle for the period of the summer service, while the West Coast ran non-stop between Euston and Carnforth. With the winter service of 1927-8 the West Coast went one better, running non-stop between Euston and Carlisle with the then-new 'Royal Scot' class 4—6—0s. Then, after a good deal of advance publicity, the L.N.E.R. announced that in May 1928 they would commence running non-stop between Kings Cross and Edinburgh, using the newly-designed corridor tenders, and taking advantage of the much reduced coal consumption of the Gresley 'Pacifics' since they had been fitted with long-lap, long-travel valves. The L.N.E.R. rightly claimed that on May 1, 1928, the 'Flying Scotsman' would make the world's record non-stop run, 392.7 miles, in both the northbound and southbound directions.

Something of the spirit of 1895 returned at this time, and in complete secrecy the West Coast planned a brief but very amusing counter-stroke to break the L.N.E.R. record before it was made, if I may be guilty of an Irish-ism. On the Friday previous to the inauguration of the Kings Cross—Edinburgh non-stop, arrangements were made for

Llandudno Junction—Holyhead stopping train passing Conway Castle, hauled by engine No. 41115

the down 'Royal Scot' to be divided and for both the Glasgow and the Edinburgh sections to be run non-stop from London to the Scottish cities. In this way the Glasgow train, hauled by a 'Royal Scot', made a non-stop run of 401.4 miles, and the Edinburgh a run of 399.7 miles. The latter train was worked by one of the Camden compounds, No. 1054. It is true that she had a load of no more than six coaches, but it was by far the longest non-stop run ever attempted with one of these engines, and was far more of a 'venture' than that of the Glasgow non-stop. At that time engines of the 'Royal Scot' class were regularly running non-stop over the 299.2 miles between Euston and Carlisle.

Compound No. 1054, like the 'Scot' on the train just ahead of her, was manned by a volunteer crew of three men—two drivers and one fireman. In the case of No. 1054 the men concerned were Drivers G. W. Langdale of Camden, and E. Ballantyne of Dalry Road, and Fireman A. Bassett. In volunteering for this job the crews concerned had asked for plenty of coal; because although the 'Scots' and the compounds were economical engines, especially on a relatively easy schedule such as that of the 'Royal Scot' in 1928, there is always the chance of encountering bad weather. A strong adverse wind can considerably increase the coal consumption if a driver is opening out to maintain his normal running time in the adverse conditions. To meet the need for increased coal capacity two long-wheelbase Midland tenders were taken from 'Class 3' Belpaire 4—4—0s and fitted with open coal rails extended to the maximum width permissible by the loading gauge. In this way it was possible to load 9 tons of coal on to each of the tenders. In actual fact No. 1054, in making the run of 6 hr. 10 min. from Euston to Edinburgh Princes Street, used 6¼ tons, showing an average consumption of 35 lb. per mile. On the basis of the work done in horsepower hours this was not a particularly good figure; but the main thing was to get through non-stop, and it must be remembered that it was a kind of duty far otherwise than that for which the engine had originally been designed.

Mention of a Camden compound brings me finally to the Birmingham expresses, although the majority of these trains were worked by engines and men from Bushbury shed, Wolverhampton. My own experiences of the work of these engines, all after the early prejudice had been overcome and the crews had thoroughly settled down to them, were perhaps typical. Most of my runs were made on the hardest train of the day, the 4.35 p.m. from Euston, which included two intermediate stops within the

In B.R. days: Liverpool—Nottingham express leaving Chinley, hauled by No. 41192, in B.R. lined black

Mounting austerity: a former Midland compound No. 1044 in black, with short Stanier chimney on a Bedford—St. Pancras stopping train

two-hour schedule. This involved running the 62.8 miles from Euston to Blisworth in 63 min. start-to-stop, and I made a number of runs on this train, on Saturday afternoons, specially to test the locomotive work. I must confess that out of five runs with the Bushbury compounds we kept strict time on only one occasion, and that curiously enough was the only time we suffered an intermediate check. On three runs, with loads of between 270 and 285 tons, our times to the Blisworth stop were 64 min. 18 sec., 65¼ min. and 67 min. exactly—the last-named run, with engine No. 1110, being uniformly poor throughout. It is noticeable, however, that speeds rarely exceeded 75 m.p.h. downhill from Tring, and in earlier days London & North Western drivers, with 'George the Fifth' class 4—4—0 locomotives, would have made equally good times with loads of 400 tons, or even more.

By far the best run I had on this train was one with engine No. 1111, again on a Saturday after-

TABLE VIII

L.M.S.R. EUSTON—BLISWORTH

Run No.			1		2	
Engine, 3-cyl. comp. No.			1111		1113	
Load tons E/F			262/285		335/365	
Dist. miles		Sch. min.	Actual m. s.	Speeds m.p.h.	Actual m. s.	Speeds m.p.h.
0.0	EUSTON	0	0 00	—	0 00	—
			sig. stop	—	—	—
1.0	*Milepost*		4 27	—	4 07	—
5.4	WILLESDEN JC.	9	10 08	61½	10 18	56½
7.0	*Brent Junc.*		11 38	65½	11 54	62
11.4	Harrow		15 47	61½	16 23	57
13.3	Hatch End		17 38	60½	18 23	55½
17.5	WATFORD JUNC.	21	21 34	69	22 41	63
21.0	Kings Langley		24 45	64½	26 09	61
24.5	Boxmoor		28 03	62½	29 43	57½
28.0	Berkhamsted		31 28	60½	33 29	54½
31.7	Tring	35	35 06	60	37 35	53½
36.1	Cheddington		38 47	77½	41 33	72½
40.2	Leighton Buzzard		41 54	80½	44 52	75
46.7	BLETCHLEY	47	46 59	72½	50 19	69½/66
52.4	Wolverton		51 32	77½	55 19	70½
54.8	Castlethorpe		53 25	73	57 22	66
59.9	Roade	59	57 57	64½	62 68	56
62.8	BLISWORTH	63	61 04		65 40	

noon, when we were stopped by signal—for no more than 25 sec. it is true, but in the middle of Camden bank, of all places! The engine was skilfully handled in getting away on the steep gradient, and was then driven with such vim that she was ahead of every other engine I have clocked on this train as early in the journey as Watford. The details of this run are shown in the accompanying table, but my very clear recollection of it is of the extent to which the engine was being thrashed. We roared the whole way up to Tring, where the minimum speed was exactly 60 m.p.h., and down the north side of the summit the sound of the exhaust never died away, even when we were running at our maximum speed of 80½ m.p.h. The compounds were definitely not at their best in this kind of running, and in commenting upon a similar series of runs in *The Railway Magazine,* in 1934, Cecil J. Allen gave his opinion that this standard of performance represented the limit of their capacity. Even after all that has been written on the subject I still feel that in the working of the two-hour Birmingham trains the 'George the Fifths' could have given them points and a beating, even in coal consumption. More of this, however, in my final chapter.

Beside this run of No. 1111 there is a fine performance by No. 1113, on a summer afternoon when the load was increased to 365 tons. Some very hard work was involved in getting this load to Blisworth on 65¾ min., though once again the maximum speed at Tring was well below the best 'George the Fifth' standards, with a train of this weight. I must emphasise that these runs of mine, on the Birmingham trains, were made when the compounds were at their very best. The drivers and firemen were used to them; they were well maintained, and they were kept in spotless external condition. It is inevitable that one makes comparisons with the famous engines they came to supersede, and in so doing I am mindful of the probability that a high-mileage compound would be a much pleasanter animal to ride than a high-mileage 'George'. But all in all, one comes definitely to the conclusion that even in the high-noon of their brilliance the compounds did not shine their brightest on North Western metals.

A former Kingmoor compound, No. 41137 on Morecambe—Leeds express crossing Crook-o-Lune viaduct

CHAPTER 11

THE PLACE OF THE COMPOUNDS IN HISTORY

With the introduction of large numbers of new Stanier 4—6—0s on the L.M.S.R. from 1934 onwards the days of the compounds, like those of many other pre-grouping designs became numbered, and while my Scottish chapter has shown that they continued to do much good work, their years of decline had begun. Nevertheless, it was not until June 1948 that the first of them were scrapped, Nos. 1002 and 1029 sharing that melancholy distinction. Although No. 1002, as M.R. No. 2633, dated from July 1903 she was so considerably rebuilt when converted from the original Johnson style that one could not state that she had lasted for 45 years. In her later style she dated from January 1919. No. 1002 did have one distinction, which she shared with 1008, 1010, 1013, 1018, 1024, 1026, 1027, 1029, 1031, 1033, 1036 and 1042, namely, that she never carried a British Railways number. All the rest had 40,000 added to their numbers. There were, of course, many superficial changes in their appearance in later years. Some of the original Midland engines acquired short chimneys, while many of them were fitted with the new Stanier style of chimney.

It is extraordinary to what extent such a detail as the chimney, or the shape of the dome cover, can alter the character of a steam locomotive in the eyes of a connoisseur, and I do know many enthusiasts who felt that the addition of the Stanier chimneys completely spoiled the appearance of the Midland compounds. As to the vexed question of liveries, one accepted the plain unlined black of the war years from 1940 onwards, and by the time the L.M.S.R. was introducing its post-war style of black, with maroon edging, the compounds had fallen so far below the category of a first-line type as to remain in plain black. But on the formation of British Railways the compounds were included among the many lesser classes that were painted in the B.R. 'lined black'. This was, of course, an exact reproduction of the old London & North Western livery, and to those who had so bitterly resented the ascendancy that Derby gained over Crewe twenty-five years earlier it seemed like a case of just retribution, albeit a retribution that had been a very long time in coming.

Personally, although I have always been an admirer and supporter of the L.N.W.R., I disliked the turn of the wheel as much as I disliked seeing the North Western engines of the 'twenties' painted in the Midland style. The delightful engine liveries of pre-grouping days were designed to suit the style of the engines they adorned, and very few locomotives of real 'character' have looked better than in the livery they first carried. The compounds in the Crewe style looked just as awkward misfits as the 'Georges' and 'Princes' did in Derby red. Of course there have been some horrible affairs put on to the road in the last twenty-odd years on which the livery did not matter. They looked as beastly in one colour as another. But the compounds, whether in Johnson's day, in Deeley's, or on the L.M.S.R., had a balanced symmetry, character and nobility of line, in which the elegance of the earlier versions developed into a dignified massiveness in the short-chimneyed engines from No. 1065 onwards.

But when all is said and done, and the sole survivor is no more than a museum piece, what is the place of these engines in the history of transport? As the one design of compound locomotive in Great Britain to be built in large numbers, and to survive for more than 40 years, they have a special place in history. But paying due regard to this fact, it is equally not true to state that they represent the *only* successful British design of compound locomotives. The superheated version of the Deeley compound developed on the Midland Railway in Fowler's day was a very good and relatively economical engine; but it was no better than its counterparts on the Great Central, and in weight haulage there can

be little doubt that the two Smith compound 'Atlantics' on the North Eastern Railway would have given the Midland engines points and a sound beating. Again, although Webb's four-cylinder system on the North Western was a complete failure in express passenger service, in heavy freight and mineral work it was a very different story, and many of the 0—8—0s put in nearly 30 years' hard work, as compounds.

Like the Lord High Executioner of Titipu, the compounds were 'wafted by a favouring gale' into a position of eminence, which they filled by reason of their own merit. It is equally certain that had railway politics been otherwise at the time of the formation of the L.M.S.R. those 45 engines might have been 'lost' among the legions of Crewe, and disappeared within a decade, bequeathing to railway history little more than a memory of their beautiful livery and lively performance with light loads. The fascinating, almost romantic, story of their burst into the limelight is interesting in its revelation of the extent to which engineering 'light' had become hidden under the 'bushel' of Midland managerial methods; and no less astonishing was the response of the Midland enginemen to the stimulus of competition in those first trials of 1923.

In looking back to the psychological aspects of the performance of engine No. 1008 one must recall that for 15 or 16 years the modest limits of loads had been rigidly applied. No section of the Midland Railway saw more piloting than that between Hellifield and Carlisle. The maximum unpiloted tonnage for a limited load train with a

No. 1009 (B.R. 41009) in lined black at Bedford in 1949

Class 4 engine had been 260 tons, and yet in these trials not only compounds but the '999' class simples were being asked to take 350 tons unassisted!

It is perhaps an exaggeration to say that the whole compound saga depended for a few critical weeks upon the driver and fireman of engine No. 1008. If they had been fainthearted, if they had not risen above the long traditions of their service, or if they had acted deliberately in a spirit of ca-canny, the whole situation would have been handed to Crewe 'on a plate'. There would have been many more trials, much more argument, and probably much less decision. One could use the Churchillian idiom, and say that never in the history of British locomotive engineering had so much been owed by so many to a single engine crew. And really it was the fireman rather than the driver who held the

A rare curiosity: No. 1074, with long Stanier chimney; Deeley dome cover, and high railed tender

One of the Johnson engines No. 1004 with short chimney B.R. number and L.M.S. tender leaving Skipton

The last of the Deeley compounds, No. 1044 with short chimney, B.R. number and L.M.S. tender

key to the whole situation in his hands. I have no doubt there were inspectors and technical staff galore to urge the driver to open his engine out more and more; but no one could take the place of the fireman. If he did not produce the steam all other efforts would have been unavailing. The Derby authorities made no mistake in selecting such a superb engine as No. 1008 for the job; the choice of the driver and fireman to work her was no less fortunate.

Having stepped from comparative obscurity into a leading rôle, and played it with degrees of success ranging from sound competence to real brilliance, one naturally comes to consider the relationship of the compounds to their contemporaries, not only on the L.M.S.R. but on other railways. The results of several pitched battles with the 'Prince of Wales' class 4—6—0s of the L.N.W.R. have already been discussed in this book. It is with contemporary 4—4—0 locomotives that I am now concerned. These designs can be put forward as rivals to the compounds for the honour of being the most effective, most powerful, 4—4—0s to have run on British metals. Southern enthusiasts will no doubt feel that there is no doubt on this question at all; the honour is unquestionably held by the 'Schools' class. On the grounds of nominal tractive effort this is certainly true; but there are other considerations to be taken into account. The performance of two other engine designs is worth analysis, and these are:

1. The L.N.W.R. 'George the Fifth' 4—4—0.
2. The L.N.E.R. 'D49' 3-cylinder 4—4—0.

The basis of comparison is that of drawbar horsepower, corrected for gradient, and considered against speed; because one has to compare the circumstances in which the power is developed. A study of the performance of the Midland compounds already quoted in this book suggests that they are not at their best in really high-speed running.

Before discussing the actual results certain factors must be borne in mind. At speeds of between 50 and 60 m.p.h. I have taken three groups of runs as follows:

L.N.W.R. Willesden—Tring
M.R. Armathwaite—Ormside
Southern Weybridge—Wootton Box

These each afford between 20 and 30 miles of continuous hard running, gradually against the collar. The North Western runs, with 'George the Fifth' class engines, all relate to running conditions of the 1911-15 period, and were made with loads varying between 370 and 445 tons gross behind the tender. The runs with 'Schools' class engines were made on the Bournemouth expresses between 1937 and the outbreak of World War II, with loads varying between 480 and 525 tons behind the tender, while the Midland compound runs are those included in the various trials over the Settle & Carlisle line. In these latter the work of No. 1008 in 1923

Engine No. 41048 double-heading a Stanier 'Black Five' near Elstree

One of the 1923 batch of 6ft. 9in. engines. No. 41061, on Bedford—St. Pancras 'fast' near Elstree

again comes out as superior to everything else done in the many tests carried out over that route.

In making an assessment of the results the train resistance is an important factor, and to bring all loads to a common basis of reckoning I have taken the most recent British Railways figures and applied them to all trains on a pounds per ton basis. Judging from the work done with the Crewe dynamometer car in the years 1910 to 1914 the modern figures for train resistance would appear to apply, with quite reasonable accuracy, to L.N.W.R. coaching stock, but with the Midland Railway it is another matter. In the trials between 1923 and 1927 the Horwich dynamometer car was used, and as a result of some enquiries by the late Sir Nigel Gresley it was found, in 1927, that the calibration of this car was wrong, and that it was registering higher drawbar pulls than were actually being made by the engines concerned. The comparative result, as between one locomotive and another on test, would be a fair one, but basically the horsepower figures were high. In an earlier chapter of this book the graph of horsepower against speed for the competitors in the 1923-4 trials is reproduced. This shows values of drawbar horsepower for No. 1008 of over 1,000 at 50 to 60 m.p.h., whereas on the strictly comparable basis of reckoning using modern figures of train resistance, the value of her biggest effort from Armathwaite to Ormside works out at no more than 820. The comparative figures are thus:

Engine Class	Average Load tons	Distance miles	Average gradient	No. of runs	Average speed	Average D.H.P.
George V	415	26.3	1 in 362	13	56.6	945
Schools	505	33.3	1 in 528	5	56.2	940
Compound . . .	370	23.3	1 in 580	1*	60.8	820

*Best run in 1923 trials

The maximum efforts of the competitors of the compounds in this comparison were an output of 1,030 for a 'George the Fifth' averaging 58.6 m.p.h. from Willesden to Tring with a load of 415 tons, and one of 1,035 with a 'School' averaging 58 m.p.h. over the 'test' course with a load of 510 tons. On the other hand, I must mention a run on the old 2 p.m. down Scotsman from Euston, which stopped at Willesden, on which an average equivalent drawbar horsepower of 1,091 was sustained over the shorter distance of 14.2 miles from Watford to Tring, in which the maximum figure, arising out of a sustained 61 m.p.h. from Berkhamsted to Tring with a 435-ton train, reached the remarkable value of 1,195 e.d.h.p.

The very finest comparable effort I can find from a compound comes in the run I myself clocked on the 1 p.m. from Carlisle to Glasgow St. Enoch, and referred to in detail in Chapter Nine. The sustained minimum speed of 43½ m.p.h. on the 1 in 150 gradient from Thornhill to the south end of Drumlanrig tunnel gives an equivalent drawbar horsepower of 1,109, while the sustained output over the 30 miles from Holywood to Upper Cairn Box works out at 950. Yet this was an exceptional effort, whereas the foregoing table shows an *average* e.d.h.p. of 945 on *thirteen* runs between Willesden and Tring by 'George the Fifth' class 4—4—0s. The seven best were 967, 970, 972, 975, 988 (2), 988 and 1,031. No compound performance on the Birmingham trains of the L.M.S.R. comes anywhere near these North Western classics of 50 years ago. Incidentally, the 'George the Fifth' efforts seem to be every bit as good as the very best done by the 'Schools' in their hey-day. On the Midland line the best I can trace is an output of 850 e.d.h.p. sustained over the 14 miles from Hendon to Sandridge Summit, north of St. Albans, in hauling a 290-ton train over this distance at an average speed of 62 m.p.h.

These analyses bear out the deficiency of the compounds at higher speeds that were so vividly revealed in E. L. Diamond's paper to the Institution of Mechanical Engineers. In this respect, one feels that they must yield pride of place to both the 'Schools' and the 'George the Fifths'. It is in heavy slogging uphill that the compounds excelled. There is a recorded instance in Scotland of engine No. 1068 putting forth an output of 1,100 e.d.h.p. at 37½ m.p.h. on the Neilson bank, and No. 917, climbing to Cobbinshaw Summit on the Edinburgh —Carstairs road, sustained 1,000, at 49 m.p.h. The outstanding performance of No. 1065 on Grayrigg bank during the Preston—Carlisle trials of 1925 has already been discussed. Against this, six good 'George the Fifth' runs up Grayrigg bank gave out-

Morecambe—Leeds express near Clapham (Yorks), with engine No. 41108

Engine No. 41090, in B.R. lined black, double-heading a Stanier 'Jubilee' on up express near Berkhamsted

puts of 880, 885, 909, 930, 971 and 1,000, while with the 'Schools', one of the best I have ever seen was 1,105 climbing from Tonbridge to Sevenoaks tunnel. Of the L.N.E.R. 'D49' class I have one outstanding record, but one only. This was the occasion on which Norman McKillop—now well known as an author—had to work the 6.38 p.m. Scotsman from Newcastle to Edinburgh with No. 249, *Aberdeenshire,* instead of the usual 'Pacific'. With a 435-ton train he sustained 46½ m.p.h. up the 1 in 200 from Reston to Grantshouse—1,100 e.d.h.p.

On the basis of published data it would be reasonable to claim that the Midland compounds were the equal of any British 4—4—0 in heavy uphill work. The 'School's' performance quoted in the previous paragraph was a hard effort, as I saw for myself on the footplate. On the other hand, in sustained fast running at 55 to 60 m.p.h. in heavy steaming conditions, the maximum efforts of the compounds have been surpassed by others. And yet the compounds have a very special place in railway history. They were strongly built, reliable engines in traffic, and they maintained their quality better than their L.N.W.R. rivals. In their years of decline, which even the most famous engines have been forced to suffer, they could still do useful work.

I shall always remember an occasion, not long before nationalisation, when I had a footplate pass to ride on the engine of the down Postal from Stirling to Aberdeen. We had a Carstairs compound and the old Scots driver was quite shocked to think I wanted to ride on her from Stirling to Perth. When I persisted he shrugged his shoulders and said, 'Ah weel, ye'll be mighty glad when we get to Pairth!' Far from it, I was sorry she was not continuing with the train to Aberdeen. At this distance in time I can now reveal that at his invitation I drove her myself, and I drove her hard and fast. She responded willingly, and rode well, especially when I took her from Gleneagles down to Dunning at over 80 m.p.h.

A fine action shot of No. 41028 ascending the Lickey Incline

At that time the whole class, 240 of them, was still in existence, though scrapping began in the following year. By December 1958 only 19 of them remained in traffic, though fortunately the pioneer of them all, No. 1000, had been saved from the scrapheap. As B.R. No. 41000 she had been withdrawn in October 1951 and scheduled for preservation. In the summer of 1953 the Institution of Locomotive Engineers paid an official visit to Crewe works and after seeing the one and only Class 8 B.R. No. 71000, newly completed, and other modern locomotives under repair we were taken to the paintshop to see the historical relics. There, among the historic North Western engines, was the old compound, and it was a shock to me to see what a decrepit and woe-begone condition she was in. I suppose someone *had* wiped her down with a rag, but that had only served to emphasise her dingy unlined black that passed for a 'livery'. It was a time of austerity, and those of us who had an interest in the old warrior could not help wondering if the time would ever come for her to be smartened up, and made into a reasonably presentable museum piece. The one comforting reflection was that she lay right at the back of the shop, and that quite an amount of shunting would have been necessary if some 'realist' suddenly decided that the time had come to end her day.

The famous engine had been moved to Crewe only a short time earlier after lying derelict for nearly two years in Derby works yard. At the time of that move from Derby to Crewe No. 1000 had acquired a different tender. For some time prior to her withdrawal from traffic she had been running with a hybrid tender, made up of a tank of the Fowler type mounted on the longer frame of the original Deeley design. But she was definitely scheduled for preservation and she was fitted with a true Deeley tender, that had previously been attached to No. 1024. Thus, for six years she languished in the paint shop at Crewe. Then at last, in the spring of 1959, she was taken back to Derby once more, for general overhaul. Connoisseurs noted that her tender was still lettered 'L.M.S.' Unfortunately that tender was found to be unserviceable, and as restored she was attached to a long-wheelbase tender of 1914 vintage that was fitted to one of the original Somerset & Dorset 2—8—0s built in Derby in that year. In the profile of the side sheeting at the front end it differed from the true Deeley compound tender. But no matter. No. 1000 was restored to working order, and after some steaming trials she was returned to the paint shop at Derby to be decked in the full Midland livery of 1914.

Time and again the affection of a railway works for the engines of bygone days has been shown in the positively loving care bestowed upon the restoration of a locomotive to the old liveries. But never, surely, has more devotion been put into the repainting of an engine scheduled for restoration than that given at Derby to the finishing of No. 1000. It is true that the style of painting in the

Engine No. 41047 climbing the Lickey Incline with a Bristol —Birmingham stopping train

Grimsby—Birmingham express near Knighton Tunnel, Leicester, with compound No. 41156 piloting an ex-L.N.E. 'B1' 4-6-0

Birmingham—Yarmouth express near Wigston Glen Parva, hauled by engine No. 41025, in 1952, the last original Midland compound engine to remain in service, other than the restored No. 1000

The first post-grouping compound, No. 1045, as B.R. 41045, on Morecambe—Leeds express near Clapham (Yorks)

Deeley-Fowler period was not so ornate as that of Johnson, when there was much more lining out, and more polished brass work. But the *finish* was always second to none, and those of us who saw No. 1000 soon after her restoration were well-nigh breathless at her magnificence—no less in our realisation once more, that the glittering engine before us was no more than representative of standard practice at Derby in days prior to 1914. From August 1959 onwards it was evident that No. 1000 was no mere museum piece, for she was out on the road once more, working special trains for railway enthusiasts.

Quite apart from the painting, however, her restoration at Derby works was very far removed from a routine job. Some consideration was actually given to restoring her to the condition of 1902, with the number 2631; but this was found impracticable, as well as representing a condition in which she was comparatively unknown. On the other hand a reasonably accurate reconstruction of the engine at the time of her rebuilding with a superheated boiler in 1914 could be attempted, and it would result in a locomotive representing an epoch in Midland history that determined the course of events on the L.M.S.R. for several eventful years after the grouping of 1923. Nevertheless, between 1914 and 1951 many alterations were made to the engine; these had to be made good by the removal of certain fittings and their replacement by different

Morecambe—Leeds express crossing Clapham viaduct; engine No. 41081

Carnforth—Leeds express, on the 'Little North Western' line: engine No. 41119

types. The determination of the exact tones of colour used in 1914 required considerable research, and the final lining out was decided upon only after examination of evidence from many sources, much of it conflicting! To add to the difficulties, a fire at Derby works had destroyed many records that would have been invaluable at the time of her restoration.

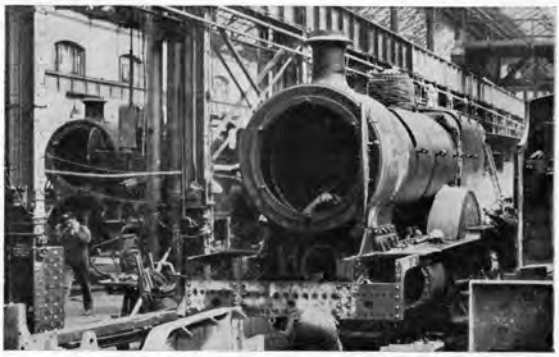
Original components were used when available, but certain items that were standard fittings in 1914, and not used in later days, had to be fitted as dummies. These included pyrometers, sight-fed lubricators, superheater damper gear, and a lock-up safety valve at the side of the whistle. On the other hand, in view of the restoration of the engine as a working unit, certain items or methods of fastening, which later experience had shown to be necessary from the viewpoint of safety, have been retained, even though they were not in evidence on the engine in 1914. These include the safety clips on the brake hangers on the tender, and the turned-up corners of the treads on the steps. Mechanical lubrication to the cylinders was provided through an atomiser—necessary at the time of restoration, because the cylinders are now of steel. The tender fitted after restoration has already been mentioned.

In the summer of 1961 the Institution of Locomotive Engineers celebrated its Golden Jubilee, and an interesting feature of the proceedings in May of that year was an exhibition of rolling stock in the goods yard at Marylebone. Within the limits of space available that exhibition was an epitome of 50 years' achievement, from 1911 to 1961, and to represent the pre-grouping era the Midland compound No. 1000 was chosen. As might be expected, for sheer splendour of finish she stole the show, even though standing immediately ahead of *Mallard*. At the time, however, the latter engine was turned out in standard British Railways dark green, and although nothing could screen her striking and attractive lines, that livery is workmanlike rather than spectacular. Had *Mallard* been decked in the garter blue she sported at the time of her world record of 1938 she might well have attracted some of the attention that was inevitably bestowed upon so striking a period piece as the compound No. 1000.

It was a time when many of the preserved locomotives were still on the active list, much in demand for special train workings, and tended with care and affection at the sheds where they were stabled. There were many who hoped that the

Morecambe—Leeds express leaving Morecambe, and passing beneath the experimental electrified section; engine No. 40931

The restored No. 1000 working an S.L.S. special on the former G.C.R. line near Leicester in September 1960



Engine No. 1000, in Derby works, May 1959 during restoration

Midland compound No. 1000 would be kept on the active list for many years to come. On the excursions she had worked since her restoration there had been ample evidence that she was still capable of hard work and high speed. But with the rapid superseding of steam throughout British Railways the question of providing servicing facilities was likely to become more and more acute, and it was unfortunately no more than natural that a time would come, all too soon, when the survival of these period pieces as working units would become an embarrassment that the modernised British Railways could not accept. And so the active days of No. 1000 came to an end, and she was installed in the National Museum of Transport at Clapham.

So, late in 1962, the chequered career of the Midland compounds finished. Today, engine No. 1000 stands in the museum as representative of a class of 240 locomotives that played an important part in the transport system of Great Britain at a critical time. The story of the class as told in this book includes two occasions that can well be described as 'near-misses', when the compounds as they were at those respective times might easily have been eclipsed in comparative trials, and would have been recorded in history as just another compound design that failed eventually to make the grade. The first of these 'near-misses' was Deeley's building of the '999' class with the 'scissors' valve gear; the second, of course, was the exclusion of an

The magnificently restored No. 1000 ready for a Stephenson Locomotive Society special in September 1959

L.N.W.R. 'George the Fifth' from the Leeds—Carlisle trials of 1923-4. Had one of those engines been included, in as perfect condition as the compound No. 1008, the L.M.S. authorities might well have had an exceedingly difficult decision to make. This final chapter has shown once again how the maximum efforts of the compounds compared with those of the 'Georges'.

It is good to have No. 1000 in the museum at Clapham, and to be able still to see what a Midland express engine of 50 years ago looked like in her prime; but I always feel that the engine preserved should have been 1008 and not 1000. It was the epic performance of No. 1008 in the trials of 1923-4, and the outstanding efforts of her driver and fireman, that changed the whole course of the compound story, and it is perhaps significant of the appreciation felt towards men and machine that in that beautiful model of the Midland Railway in the Derby Municipal Art Gallery it is No. 1008 that represents the compounds. At Clapham, No. 1000 stands in a distinguished company, and in the case of two engine classes that have each written a brilliant page in British locomotive history it is the record-breakers, rather than the pioneers, that have been preserved: *Hardwicke,* representing the North Western 'Precedents', and *Mallard,* representing Sir Nigel Gresley's 'A4' Pacifics.

It must be admitted that the claim of No. 1008 over that of No. 1000 is more subtle, and one more to be appreciated by the connoisseurs of locomotive performance. *Hardwicke* and *Mallard* were record-breakers in a sense that has universal appeal. But the main thing is that a compound *has* been preserved, and a true Midland compound at that. One cannot stand beside No. 1000 in the museum without there welling up memories of the Midland Railway in days before there was such a thing as the L.M.S.R.; and I end, therefore, where I began, with thoughts of the Manchesters pounding their way up to Peak Forest, of spotless engines and trains making a brilliant spectacle amid the smoke and grime of the West Riding, and of Scotch expresses making their arduous way up to Aisgill.

The last journey: engine No. 1000 and her tender, on arrival in the Transport Museum, Clapham, on December 9, 1962

CHAPTER 12

CASE HISTORIES

SUMMARY OF ORIGINAL MIDLAND COMPOUNDS

Pre-1907 No.	1907 No.	Order No.	Built Derby	Rbt. G9AS (sup.) (a)	B.R. No. (40000 added)	Withdrawn	Notes on Boiler Pressure
2631	1000	2109	1/02	11/14(b)	P.6/49	P.10/51	B.P. reduced to 190 lb. 6/16, inc. to 200 lb. 11/22
2632	1001	,,	,,	1/15(b)	P.13/48	P.11/51	B.P. reduced to 190 lb. 7/16 ,inc. to 200 lb. 4/22
2633	1002	,,	7/03	1/19(c)	—	P.6/48	B.P. inc. to 200 lb. 5/23
2634	1003	,,	9/03	5/15(b)	P.9/48	P.4/51	B.P. reduced to 190 lb. 11/16, inc. to 200 lb. 5/23
2635	1004	,,	11/03	11/14(b)	P.4/49	P.2/52	B.P. reduced to 190 lb. 1/18, inc. to 200 lb. 10/22
1000	1005	2889	10/05	3/23	P.11/49	P.7/51	
1001	1006	,,	11/05	8/22	P.10/49	P.5/51	
1002	1007	,,	,,	6/22	P.12/48	P.5/52	
1003	1008	,,	,,	7/19(d)	—	P.7/49	B.P. inc. to 200 lb. 5/22
1004	1009	,,	12/05	11/22	P.13/48	P.13/51	
1005	1010	,,	,,	1/27	—	P.7/49	
1006	1011	,,	,,	12/22	P.5/49	P.2/51	
1007	1012	,,	,,	7/21(d)	P.4/49	P.1/51	B.P. inc. to 200 lb. 2/22
1008	1013	,,	,,	3/25	—	P.6/49	
1009	1014	,,	,,	5/19(d)	P.9/48	P.5/52	B.P. inc. to 200 lb. 7/22
1010	1015	2998	3/06	5/21(d)	P.9/49	P.12/51	B.P. inc. to 200 lb. 2/22
1011	1016	,,	,,	5/22	P.3/49	P.11/51	
1012	1017	,,	,,	1/26	P.12/48	P.8/50	
1013	1018	,,	4/06	12/26	—	P.7/48	
1014	1019	,,	,,	4/24	P.6/48	P.12/51	
1015	1020	,,	,,	2/22(d)	P.8/49	P.5/51	B.P. inc. to 200 lb. 12/23
1016	1021	,,	,,	9/27	P.10/48	P.10/52	
1017	1022	,,	5/06	1/28	P.1/49	P.4/50	
1018	1023	,,	,,	12/22	P.6/48	P.8/51	
1019	1024	,,	,,	3/22	—	P.10/48	
1020	1025	,,	,,	10/24	P.1/49	P.1/53	
1021	1026	,,	6/06	10/27	—	P.9/48	
1022	1027	,,	,,	8/26	—	P.10/48	
1023	1028	,,	,,	11/23	P.6/49	P.10/52	
1024	1029	,,	7/06	5/24	—	P.6/48	
1025	1030	,,	9/06	4/25	P.2/49	P.9/51	
1026	1031	,,	,,	11/22	—	P.12/49	
1027	1032	,,	10/06	1/26	P.1/49	P.3/52	
1028	1033	,,	,,	10/23	—	P.9/48	
1029	1034	,,	12/06	1/23	P.11/48	P.5/50	
—	1035	3410	11/08	6/22	P.9/48	P.5/52	
—	1036	,,	,,	11/23	—	P.10/48	
—	1037	,,	12/08	1/21(d)	P.5/48	P.3/51	B.P. inc. to 200 lb. 6/22
—	1038	,,	,,	11/22	P.1/49	P.8/52	
—	1039	,,	,,	9/20(d)	P.10/48	P.6/50	B.P. inc. to 200 lb. 3/22
—	1040	,,	1/09	7/13(b)	P.8/49	P.5/52	B.P. reduced to 190 lb. 9/16, inc. to 200 lb. 1/23

SUMMARY OF ORIGINAL MIDLAND COMPOUNDS (continued)

Pre-1907 No.	1907 No.	Order No.	Built Derby	Rbt. G9AS (sup.) (a)	B.R. No. (40000 added)	With-drawn	Notes on Boiler Pressure
—	1041	3410	1/09	5/23	P.2/49	P.12/51	
—	1042	,,	2/09	6/20(d)	—	P.6/49	B.P. inc. to 200 lb. 10/22
—	1043	,,	3/09	12/25	P.1/50	P.13/51	
—	1044	,,	,,	12/26	P.3/49	P.10/52	

NOTES:

(a) Boiler pressure of engines when rebuilt with G9AS boilers was 200 lb. except those marked (b), (c) and (d).
(b) Boiler pressure 220 lb. (c) Boiler pressure 195 lb. (d) Boiler pressure 190 lb.
In the above list calendar months are used for the building and rebuilding dates and L.M.R. four-weekly periods for the renumbering and withdrawal dates.
The rebuilding with G9AS superheated boilers was carried out under the following Derby orders:—

Order No.	Engine Nos.	Order No.	Engine Nos.
3985	1000-4	5741	1023/33/4/6/41
4211	1040	5921	1019/25/8/9/30
5273	1006/7/8/12/4	6291	1017/27/32/43/4
5274	1015/6/20/4/31/5/7/8/9/42	6550	1018/21/2/6
5740	1005/9/10/1/3		

The numbering of the first of these orders would suggest that it was originally intended to rebuild the Johnson engines about 1910-11, but, as has already been seen, the first engine to be superheated was No. 1040 in 1913.

SUMMARY OF L.M.S. STANDARD COMPOUNDS

Engine No.	Builder	Works or Order No.	Built
1045-1064	Derby	O. No. 5938	1924
1065-1084	,,	O. No. 6066	,,
1085-1104	,,	O. No. 6293	1925
1105-1114	,,	O. No. 6354	,,
1115-1134	Horwich	1384-1403	1925-26
1135-1159	N.B. Loco Co. (Q.P.)	23229-23253	1925
1160-1184	Vulcan Foundry	3833-3857	1925
1185-1199	,, ,,	3998-4012	1927
900-909	,, ,,	4013-4022	,,
910-924	,, ,,	4033-4047	,,
925-934	,, ,,	4023-4032	,,
935-939*	Derby	O. No. 8078	1932

*Nos. 925-939 were originally intended to be built to Crewe order No. E366.

In the list that follows calendar months are used for dates up to September 1924, and L.M.S./L.M.R. four-weekly periods for dates commencing P.10/24. This is in accordance with the Derby records, although L.M.S. general records do not normally give the date in periods until 12th September, 1927.

Engine No.	Date Built	B.R. No. (40000 added)	Withdrawn	Engine No.	Date Built	B.R. No. (40000 added)	Withdrawn
1045	2/24	P.5/49	P.6/57	1059	6/24	P.13/48	P.12/55
1046	,,	P.8/48	P.1/53	1060	,,	P.8/48	P.3/58
1047	,,	P.11/48	P.2/54	1061	,,	P.2/49	P.6/55
1048	3/24	P.13/48	P.11/57	1062	,,	P.12/48	P.5/59
1049	,,	P.6/48	P.3/59	1063	7/24	P.11/48	P.10/60
1050	,,	P.13/48	P.6/56	1064	,,	P.3/49	P.1/57
1051	,,	P.13/48	P.11/54	1065	,,	P.6/48	P.3/56
1052	4/24	P.10/48	P.4/53	1066	8/24	P.8/49	P.5/58
1053	,,	P.7/48	P.6/56	1067	,,	P.1/49	P.2/55
1054	,,	P.7/49	P.10/54	1068	,,	P.13/48	P.12/58
1055	,,	P.11/48	P.3/53	1069	9/24	P.11/49	P.12/55
1056	5/24	P.12/48	P.11/53	1070	,,	P.9/48	P.12/55
1057	,,	P.3/49	P.5/53	1071	,,	P.2/49	P.3/58
1058	,,	P.11/49	P.2/54	1072	,,	P.5/48	P.11/55

SUMMARY OF L.M.S. STANDARD COMPOUNDS (continued)

Engine No.	Date Built	B.R. No. (40000 added)	Withdrawn	Engine No.	Date Built	B.R. No. (40000 added)	Withdrawn
1073	P.10/24	P.7/48	P.9/57	1141	P.7/25	P.13/49	P.9/54
1074	,,	P.7/48	P.8/54	1142	,,	P.12/48	P.7/56
1075	,,	P.5/49	P.4/57	1143	,,	P.12/48	P.3/59
1076	P.11/24	P.10/48	P.5/55	1144	,,	P.11/48	P.3/58
1077	,,	P.7/48	P.4/57	1145	,,	P.4/48	P.10/53
1078	,,	P.1/49	P.9/58	1146	,,	P.8/48	P.11/54
1079	,,	P.7/50	P.11/56	1147	P.8/25	P.6/48	P.3/56
1080	,,	P.7/49	P.1/54	1148	,,	P.6/50	P.3/53
1081	P.12/24	P.7/48	P.12/55	1149	,,	P.6/48	P.8/55
1082	,,	P.6/48	P.4/54	1150	,,	P.6/49	P.10/57
1083	P.13/24	P.4/48	P.13/58	1151	,,	P.12/48	P.1/57
1084	,,	P.5/48	P .6/54	1152	P.9/25	P.12/48	P.3/58
1085	P.5/25	P.5/50	P.1/57	1153	,,	P.5/49	P.11/57
1086	,,	P.11/48	P.5/58	1154	,,	P.10/48	P.8/55
1087	P.6/25	P.5/48	P.11/54	1155	,,	P.9/49	P.3/57
1088	,,	P.1/49	P.13/56	1156	,,	P.13/48	P.9/58
1089	,,	P.7/48	P.7/57	1157	,,	P.6/48	P.5/60
1090	P.7/25	P.11/48	P.13/58	1158	,,	P.5/50	P.9/59
1091	,,	P.5/48	P.4/55	1159	P.10/25	P.13/48	P.4/58
1092	,,	P.5/48	P.8/53	1160	P.9/25	P.2/49	P.10/56
1093	,,	P.2/49	P.7/58	1161	,,	P.4/49	P.12/55
1094	,,	P.11/48	P.1/59	1162	,,	P.12/48	P.6/60
1095	P.8/25	P.12/48	P.2/58	1163	,,	P.2/49	P.12/58
1096	,,	P.6/48	P.5/54	1164	,,	P.10/48	P.11/58
1097	,,	P.9/48	P.5/56	1165	,,	P.3/49	P.3/59
1098	,,	P.13/48	P.6/57	1166	,,	P.7/48	P.10/56
1099	P.9/25	P.13/48	P.12/53	1167	P.10/25	P.7/48	P.11/58
1100	,,	P.2/49	P.4/59	1168	,,	P.10/48	P.7/61
1101	,,	P.5/48	P.8/59	1169	,,	P.11/48	P.7/55
1102	P.10/25	P.5/49	P.13/58	1170	P.11/25	P.5/48	P.4/56
1103	,,	P.13/48	P.12/57	1171	,,	P.2/50	P.13/52
1104	,,	P.3/49	P.8/55	1172	,,	P.2/49	P.8/57
1105	P.11/25	P.6/49	P.10/57	1173	,,	P.9/49	P.2/59
1106	,,	P.7/48	P.7/58	1174	,,	P.6/48	P.2/54
1107	,,	P.6/49	P.10/55	1175	,,	P.1/49	P.4/55
1108	,,	P.12/49	P.1/57	1176	,,	P.6/48	P.1/55
1109	P.12/25	P.6/49	P.13/52	1177	,,	P.7/48	P.12/55
1110	,,	P.1/50	P.8/54	1178	,,	P.10/48	P.13/53
1111	,,	P.11/48	P.5/58	1179	P.12/25	P.2/50	P.9/57
1112	,,	P.2/50	P.11/57	1180	,,	P.4/48	P.3/57
1113	,,	P.6/48	P.13/58	1181	,,	P.5/48	P.11/57
1114	P.13/25	P.11/48	P.5/58	1182	P.12/25	P.13/49	P.13/52
1115	P.6/25	P.9/48	P.5/54	1183	,,	P.7/48	P.2/55
1116	P.7/25	P.7/48	P.12/57	1184	P.13/25	P.12/49	P.6/53
1117	P.8/25	P.13/48	P.5/55	1185	P.2/27	P.8/51	P.11/57
1118	,,	P.8/49	P.1/58	1186	,,	P.11/50	P.9/57
1119	P.9/25	P.2/49	P.12/58	1187	,,	P.13/48	P.7/56
1120	P.10/25	P.13/49	P.6/59	1188	P.3/27	P.5/48	P.12/55
1121	,,	P.6/48	P.2/59	1189	,,	P.11/49	P.7/58
1122	P.11/25	P.12/48	P.13/58	1190	,,	P.6/49	P.1/58
1123	P.11/25	P.5/49	P.13/59	1191	,,	P.8/49	P.3/56
1124	,,	P.7/49	P.1/55	1192	,,	P.12/48	P.6/57
1125	P.13/25	P.8/49	P.2/53	1193	,,	P.5/48	P.11/58
1126	,,	P.13/48	P.11/56	1194	,,	P.7/48	P.9/57
1127	,,	P.7/49	P.8/55	1195	,,	P.13/48	P.12/57
1128	,,	P.12/48	P.3/56	1196	,,	P.7/48	P.7/58
1129	,,	P.13/49	P.6/55	1197	,,	P.6/48	P.5/57
1130	P.1/26	P.9/49	P.9/55	1198	,,	P.13/49	P.12/55
1131	,,	P.7/50	P.3/56	1199	P.4/27	P.10/48	P.1/58
1132	P.2/26	P.5/48	P.10/56	900	,,	P.11/48	P.4/56
1133	,,	P.12/48	P.10/54	901	,,	P.5/49	P.6/54
1134	,,	P.13/49	P.10/54	902	,,	P.6/49	P.8/56
1135	P.6/25	P.3/49	P.9/55	903	,,	P.4/49	P.9/55
1136	,,	P.9/48	P.10/55	904	,,	P.10/49	P.3/57
1137	P.7/25	P.5/48	P.4/56	905	,,	P.9/48	P.12/53
1138	,,	P.9/49	P.12/54	906	,,	P.1/49	P.1/55
1139	,,	P.11/49	P.10/54	907	,,	P.6/49	P.10/60
1140	,,	P.4/51	P.5/57	908	P.5/27	P.9/48	P.7/55

SUMMARY OF L.M.S. STANDARD COMPOUNDS (continued)

Engine No.	Date Built	B.R. No. (40000 added)	Withdrawn	Engine No.	Date Built	B.R. No. (40000 added)	Withdrawn
909	P.5/27	P.11/49	P.7/56	925	P.5/27	P.5/49	P.12/59
910	P.6/27	P.5/48	P.6/56	926	,,	P.10/49	P.8/57
911	,,	P.13/48	P.13/52	927	,,	P.9/48	P.7/57
912	,,	P.13/49	P.4/55	928	P.7/27	P.13/49	P.3/58
913	,,	P.9/48	P.8/55	929	P.5/27	P.10/48	P.7/56
914	,,	P.6/48	P.9/54	930	,,	P.4/50	P.4/57
915	,,	P.1/49	P.12/55	931	,,	P.9/48	P.11/58
916	P.7/27	P.3/49	P.8/55	932	P.6/27	P.9/49	P.5/56
917	,,	P.13/49	P.13/56	933	,,	P.7/48	P.4/58
918	,,	P.2/49	P.13/52	934	,,	P.3/49	P.3/57
919	,,	P.4/48	P.1/54	935	P.9/32	P.11/49	P.4/58
920	,,	P.7/48	P.5/58	936	,,	P.6/48	P.1/61
921	,,	P.7/48	P.12/55	937	,,	P.5/48	P.4/58
922	,,	P.13/49	P.13/52	938	,,	P.7/48	P.8/56
923	,,	P.3/49	P.11/54	939	,,	P.11/49	P.11/56
924	,,	P.9/48	P.3/55				

ALLOCATIONS

Depot	1933	September, 1949*	December, 1958
Camden	1105-10/2/34	Nil	Nil
Rugby	1122/52-6	1090, 1105/52/65/74	41162
Bushbury	1113/61-9	Nil	Nil
Monument Lane	1128/9/60/70/2/3/4	1111/5/6/22/51/66/72	40936, 41168
Crewe North	1115/8-21/5/33	1112/60/7/73	Nil
Chester	1111/4/6/50/1/8	900/33,/1098,1106/7/8/20/ 1/53/7/8/62/3/4/9/70	41158
Llandudno Junction	Nil	925/36, 1086/93, 1114/8/9/ 23/4/50/61	41120
Edge Hill	1157/9	Nil	Nil
Brunswick	Nil	926	Nil
Longsight	1130/1/2	1113/59/68	Nil
Carnforth	1117/23/4/6/7/71	Nil	Nil
Kingmoor	1065-9,1135-49/75-8	1129/39-43/6	Nil
Durranhill	929-32, 1073/5	Nil	Nil
Dumfries	Nil	902/4/12, 1109/35/71/5/9	Nil
Stranraer	Nil	1092/9, 1127	Nil
Kentish Town	1033-43/51-5/74	930,1050/1/4/71/7, 1117/99	Nil
Kettering	Nil	1011/23/48/95	Nil
Leicester	1003/4/99, 1100-4	1041/89	Nil
Bedford	Nil	1007/9/17/31/4/8/44/70/ 91/4	Nil
Nottingham	925-8, 1092-7	929, 1015/9/32/82/96	Nil
Derby	933-6, 1044-50/ 7-61/98	927,1000/3/6/57/9/60/75/ 83/4/8, 1196/7	41049,41143
Rowsley	Nil	1094	Nil
Millhouses	1005-8/32/56/76-9	1014/6/21/37/62/3/72/9, 1198	40907
York	1091	Nil	Nil
Trafford Park	1014-22/62/3/4/89/90	910, 1052/5/66/76, 1154/ 6/81	41157
Holbeck	1009-13/70/1/2/85-8	932, 1020/40/65/8/9/87, 1144	41094, 41100
Manningham	Nil	1004/43/67, 1137	41063
Lancaster	Nil	931, 1005/22/45/53/6/80/1	41101

*L.M.S. numbers shown throughout for clarity

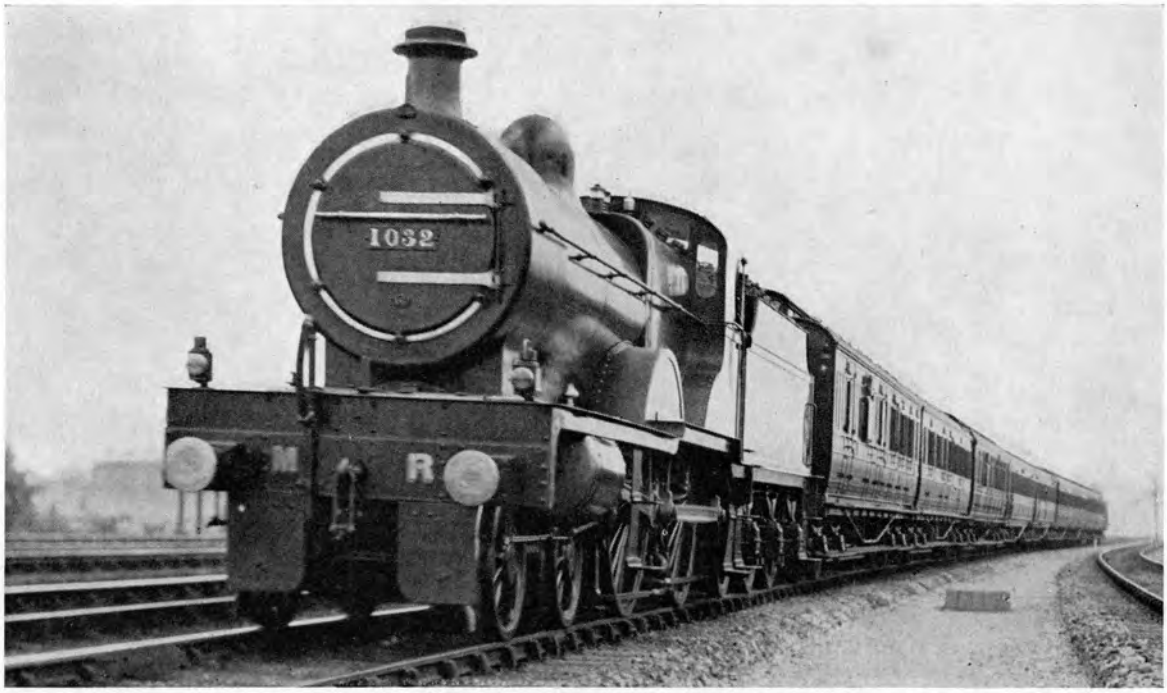
ALLOCATIONS (continued)

Depot	1933	September, 1949*	December, 1958
Saltley	Nil	928, 1046	41121/65/73
Bournville	Nil	917/34, 1061/4/73	40925, 41062
Bristol	1023-31	935, 1012/28/30	Nil
Gloucester	1000/1/2	1001/25/39/47/58/74/8/97	41123
Bank Hall	937, 1191/2/3	937	Nil
Southport	1189/90	1085, 1193	Nil
Accrington	Nil	1100/1/2/87/8/94	Nil
Blackpool	1194-7	1185/92/5	Nil
Wakefield	1198/9	Nil	Nil
Low Moor	1185-8	1186	Nil
Bolton	Nil	1103/4/89/90/1	Nil
Polmadie	900-9, 1083/4	916,1131	Nil
Greenock	Nil	1148/9/82	Nil
Dalry Road	919/20	911,1177/8	Nil
Carstairs	917	901/3/7, 1130/6/45/7/80	Nil
Perth (South)	921-4/39	921/2/3/38/9, 1125	Nil
Aberdeen	918/38, 1183/4	1134/76/84	Nil
Corkerhill	911-4, 1080/1/2, 1179/80	905/6/9/14/5/9	Nil
Hurlford	915/6	1110	Nil
Ayr	910,1181/2	908/20, 1132/3/8/55/83	Nil
Balornock	Nil	918, 1126/8	Nil
Stirling	Nil	913/24	Nil

*L.M.S. numbers shown throughout for clarity

MIDLAND COMPOUND CHRONOLOGY

January	1902	First two compounds, completed
January	1904	Deeley appointed C.M.E.
October	1905	First Deeley compound No. 1000/1005
March	1906	First shallow-framed compound 1010/1015
March	1907	Engine renumbering
March	1909	Deeley resigned : Fowler appointed
July	1913	First superheater compound 1040
November	1914	No. 2631 (then 1000) rebuilt with superheater
March	1923	Valve setting trials with 1011
December	1923	First Leeds—Carlisle trials (1008)
February	1924	First 6 ft. 9 in. compound (1045)
July	1924	First short chimneyed compound (1065)
November	1924	Second series of Leeds—Carlisle trials (1023, 1065, 1066)
February	1925	Steaming trials (1060, 1065)
May	1925	First left-hand drive compound (1085)
May	1925	Preston—Carlisle trials (1065)
April	1928	Euston—Edinburgh non-stop run (1054)
June	1948	First Johnson compound scrapped (1002, 2633)
June	1948	First Deeley compound scrapped (1029)
July	1951	Engine No. 1000 withdrawn
December	1952	First L.M.S. standard compounds scrapped
August	1958	Engine No. 1000 restored, and in traffic on special trains
July	1961	Last compound withdrawn (1168)
December	1962	Engine No. 1000 placed in museum at Clapham



11.30 a.m. ex-St. Pancras, Anglo-Scottish express near Hendon hauled by No. 1032

FAREWELL FLASHBACK TO NON-SUPERHEATER DAYS

Up Manchester express near Harpenden hauled by No. 1042

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INDEX

Illustrations are denoted in bold type

Allocations
Scotland (1933), 112
Years 1933, 1949, and 1958, 153–4

Boilers
Johnson engines 2631–2, 20
Comparison: 2631 and 1005, 39
Superheated Deeley engines, 61
Standard L.M.S. engines, 80

Cabs
1043 (non-superheater), 54
1000 (superheated), 55
1197 (standard L.M.S.), 82
Chronology, 155
Coal consumption, 52, 81, 92
Compounds, Midland
Design features, 19, 20, 39, 51, 56, 61, 80
Reference to batches,
Engine Nos. 1000–9, 37; Nos. 1010–1029, 39; Nos. 1045–1064, 71; Nos. 1065–1084, 76; Nos. 900–924, 111; Entire class, 92
Individual engines (old numbers where applicable in brackets)
Engine Nos. 1000 (2631), 18, 21, 23, 24, 37, 145 *et seq.*, **18, 29, 51, 53, 61, 148, 149;** No. 1001 (2632), 18, 21, 35, **22, 29;** No. 1002 (2633), **23;** No. 1003 (2634), 132, **20, 52;** No. 1004 (2635), **28, 71, 141,** No. 1005 (1000), 37, 130, **36, 56;** No. 1007, **42, 57;** No. 1008 (1003), 65 *et seq.*, 94, 134, 140 *et seq.*, **41, 43;** No. 1009, **43, 140;** No. 1010, **47;** No. 1011, 44, 58; No. 1012, 45, **59;** No. 1013 (1008), 44, 45, **39, 61;** No. 1014, **57, 71;** No. 1016, **43;** No. 1019, **45;** No. 1021, **45;** No. 1022, **66, 74;** No. 1023, 78 *et seq.*; No. 1025, **145;** No. 1028, **58, 64, 144;** No. 1029, **75;** No. 1030 (1025), **36;** No. 1031, **40;** No. 1038, **93;** No. 1039, 52, **66, 87;** No. 1040, 50, 52, 54; No. 1042, **48;** No. 1043, 52, **50;** No. 1044, **137, 144;** No. 1045, **62, 146;** No. 1047, 107, **69, 101, 145;** No. 1048, **66, 141;** No. 1049, 128; No. 1053, **67, 86;** No. 1054, 135, **70, 80;** No. 1056, **77, 78;** No. 1059, 99; No. 1060, 80 *et seq.*, 94; No. 1061, **63, 142;** No. 1065, 77, 80 *et seq.*, 94, **95;** No. 1066, 79, 94, **94;** No. 1067, **89;** No. 1068, **90;** No. 1069, 118, **91, 123;** No. 1071, **85, 125;** No. 1073, 94; No. 1074, **140;** No. 1075, **74;** No. 1077, **112;** No. 1078, **73;** No. 1080, 102; No. 1081, **86, 146;** No. 1083, **122;** No. 1090, **144;** No. 1093, **134;** No. 1094, **127;** No. 1097, **83;** No. 1099, **116, 127;** No. 1101, **129;** No. 1102, **103, 128;** No. 1108, **104, 148;** No. 1111, 137, **132;** No. 1112, **100;** No. 1113, 137; No. 1115, **103, 135;** No. 1118, **134;** No. 1119, **147;** No. 1127, 119; No. 1128, 121; No. 1129, **117;** No. 1132, 134; No. 1134, **81;** No. 1136, **116, 120;** No. 1137, **138;** No. 1140, 112, **113, 117;** No. 1141, **82;** No. 1142, **116;** No. 1143, 124; No. 1145, **113;** No. 1146, **114;** No. 1150, **84;** No. 1151, **83;** No. 1152, **87;** No. 1156, **145;** No. 1160, **101;** No. 1165, **106;** No. 1167, **105, 107;** No. 1168, **109;** No. 1169, **108;** No. 1176, 121; No. 1179, **120;** No. 1187, **98;** No. 1191, **79, 130;** No. 1192, **136;** No. 900, **113;** No. 901, 122; No. 903, 115; No. 905, 115; No. 907, **116;** No. 910, **112;** No. 913, 117; No. 916, **115;** No. 920, **116, 127;** No. 921, **115;** No. 923, **111;** No. 931, **147;** No. 933, 130; No. 936, 131, **131, 132, 133**
Compounds, other than Midland
De Glehn, 20, 48
St. Gothard, 12
N.E.R. No. 1619, 14, **15**
Von Borries, 12
Webb, 12

Drawings
Cross-section, No. 2631, 21
Cross-section standard L.M.S., 88
Deeley regulator, 38
Deeley smokebox and chimney, 37
Dimensional diagrams (1619, 2631, 1085), 30, 31
Fowler chimney, 59
Safety valves, No. 2631, 22
Smokebox, No. 2631, 19
Test result diagrams, No. 2631, 30, 31

Edinburgh non-stop run, 135
Engineers
Ahrons, E. L., 54
Anderson, J. E., 47,73
Beames, H. P. M., 63
Bond, R. C., 58, 99
Churchward, G. J., 49
Deeley, R. M., 34, 42, 49, **34**
Diamond, E. L., 82, 95, 132
Fowler, Sir Henry, 50, 63, 97, 105, **58**
Hughes, George, 51, 63
Johnson, S. W., 11, 29, 34, **16**
Paget, Sir Cecil, 35, 40, **34**
Robson, A. E., 47
Smith, W. M., 11, 24, **12**
Stanier, Sir William, 47
Symes, S. J., 47
Worsdell, T. W., 12
Worsdell, Wilson, 11

Foreign workings (compounds)
G.W.R., 107, **101**
L.N.W. line, 75, 102, 126 *et seq.*
Scotland, 110 *et seq.*

Granet, Sir Guy, 35, 50, 63

Horsepower, 24, 60, 69, 142 *et seq.*

Indicator diagrams, 25, 26, 27, 84

Locomotives, other than compound
Caledonian 4–4–0, 76
Great Western
North Star, 48, 49
Launceston Castle, 105
L. & N.W.R.
'Claughton', 76, 90 *et seq.*
'George V', 141

Locomotives, other than compound, *contd.*
'Precursor', 39
'Prince of Wales', 65, 90 *et seq.*
L. & Y.R.
Hughes 4–6–0, 90 *et seq.*
Midland
2–4–0 No. 1526, **13**
4–4–0 No. 2201, **13**
4–4–0 No. 2607, **14**
'999' class, 16, 49, 52, 65, **36**, **51**, **56**
4–2–2 No. 672, **48**
'Class 2' Superheater, 50, 73
North Eastern
'R' class 4–4–0, 16
Southern Railway
'Schools' 4–4–0, 141
Logs of runs
Ayr — Stranraer (1069), 118
Carlisle – Blea Moor (2631), 24
Carlisle – Carstairs (1140), 112
Carlisle – Leeds (1008), 65–68
Carlisle – St. Enoch (913), 117
Carstairs – Carlisle (901), 122
Cheadle Heath – Leicester (1012/1013), 45
Cheltenham – Birmingham (936), 131
Derby – Manchester (933), 130
Edinburgh – Symington (1176), 121
Euston – Blisworth (1111/1113), 137
Forfar – Glasgow (1127), 119
Glasgow – Perth (1128), 121
Hellifield – Carlisle (2631), 23
Kettering – St. Pancras (1040), 54
Leeds – St. Pancras (1011), 44
Leeds – Carlisle (1008), 66, 70, 71
Leeds – Carlisle (1065), 82
Leeds – Trent (1049), 128
Leicester – Derby (1005), 130
Leicester – St. Pancras (1003), 132
Leicester – St. Pancras (1013), 44
Paddington – Bath (1047), 108
St. Pancras – Kettering (1008), 134
Shrewsbury – Crewe (1132), 134
Stonehaven – Stirling (1143), 124
Symington – Carnforth (905, 903), 115
Wilmslow – Euston (1080), 102
London Midland & Scottish Rly., 62 *et seq.*, 100, 102, 139

Mechanical Engineers, Institution of, 11, 50, 82, 95, 106
Midland Rly.
Engine classification, 40
Renumbering (1907), 39
Reorganisation (Granet), 37

Oil firing
Apparatus, 97
Engine performance, 99
Photographs
No. 1038, **93**
No. 1066, **94**
No. 1069, **91**

Proposed compounds
Deeley 2–4–4–2 tank, 47
Deeley 4 cyl., 4–6–0, 47, **46**
Fowler 3 cyl., 4–6–0, 95, **96**

Tests
Engine No. 2631 in 1902 (Leeds – Carlisle), 22 *et seq.* 32, 33
No. 1032 (Waverley route), 41
No. 1011 (Derby – Manchester 1923), 58
No. 1008 (Leeds – Carlisle 1923–24), 63 *et seq.*
Diamond's analysis (1065), 83 *et seq.*
Launceston Castle, 105
Leeds – Carlisle 1924–25 (1023, 1065, 1066), 76 *et seq.*
Preston – Carlisle (1065), 89 *et seq.*
Steaming trials (1060, 1065), 80 *et seq.*
Superheating (1910–1913), 52

Valve gears, 58 *et seq.*